The MINING CONGRESS JOURNAL

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The MINING CONGRESS JOURNAL

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Treatment of Complex Ores in the Southwest

How We Look For Mines

Is the Old Prospector Necessary

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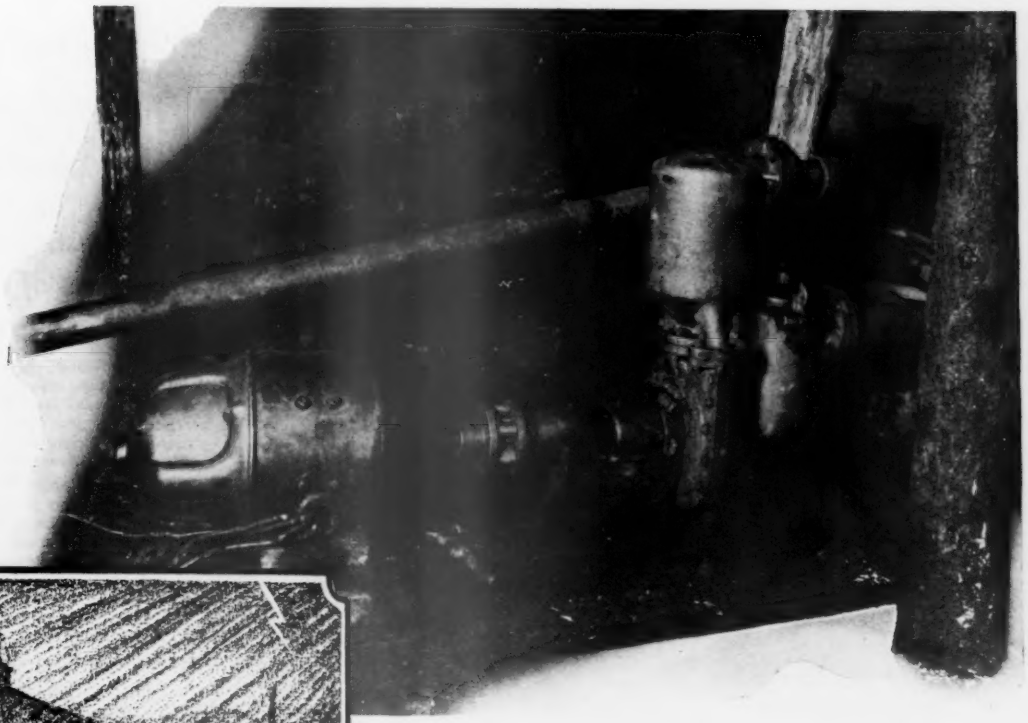

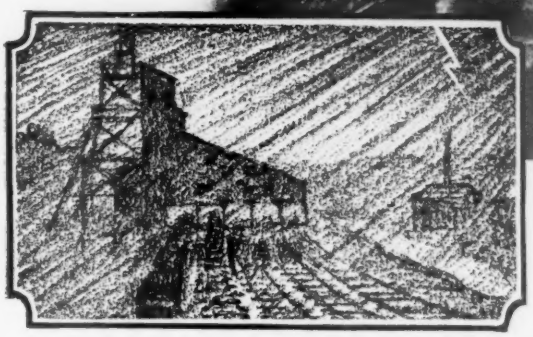

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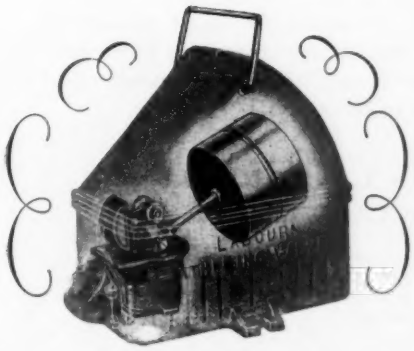

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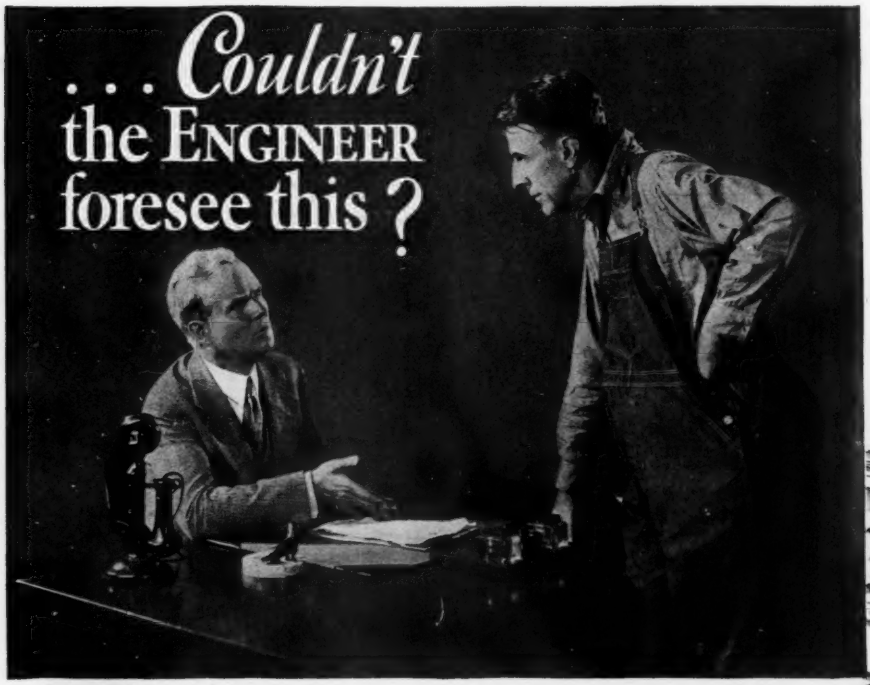

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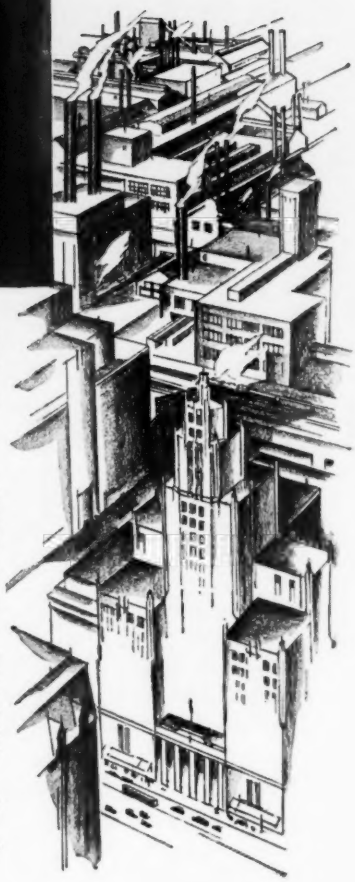

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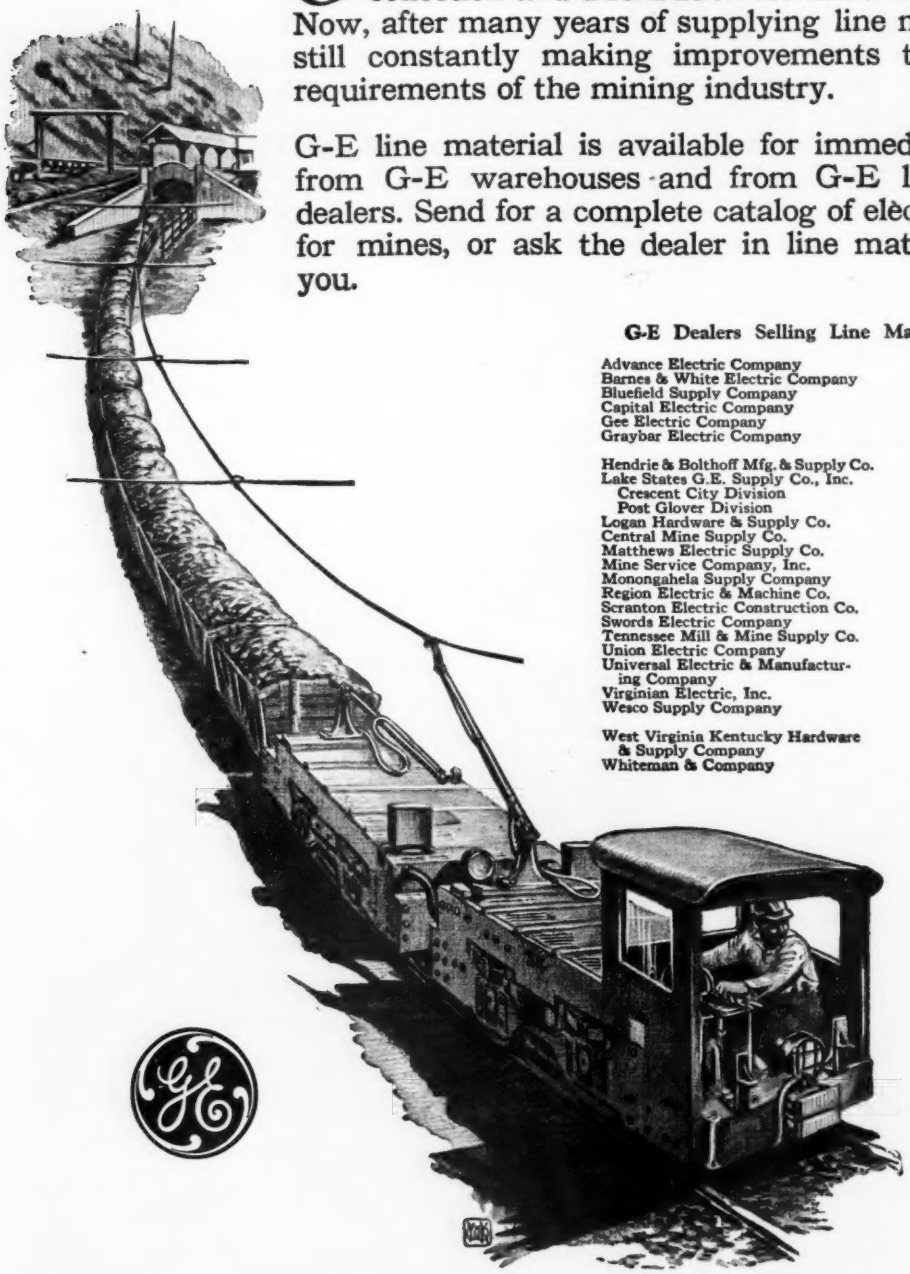

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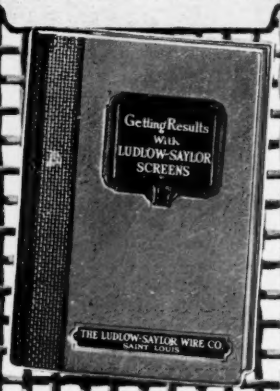

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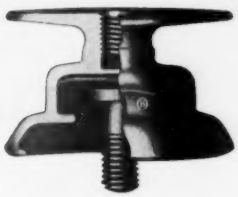

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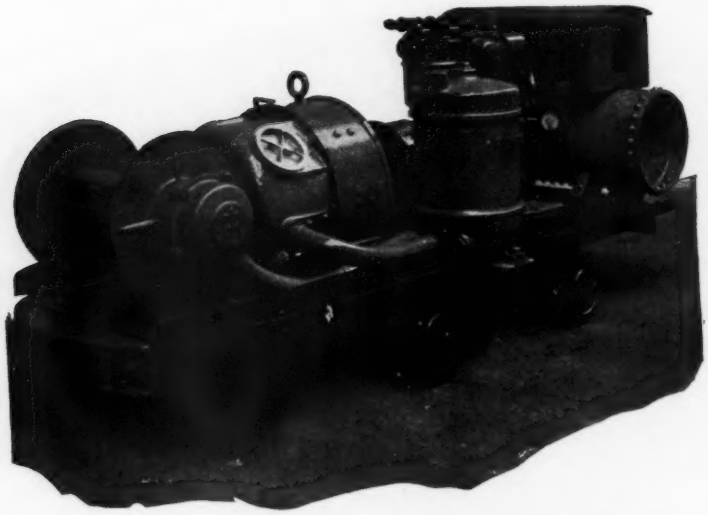

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The
MINING CONGRESS JOURNAL

A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress

VOLUME 15 FEBRUARY, 1929 No. 2

Editorials

The Special Session

IT NOW seems certain that a special session of Congress will be called shortly after the inauguration of President-elect Hoover. The effect of this certainty on the present Congress, and the probable result of a special session are causing much concern, and from many quarters fear has been expressed that the plan for a special session will place a premium upon legislative delay and throw business that should be disposed of by the present session into the special session. It is also contended that the consideration of the tariff will produce a disturbing influence on general business.

Whether these fears will be realized or not, it is already evident that the prospect of a special session has resulted in a movement to effect a general revision of the tariff law. Hearings before the Ways and Means Committee of the House have been in progress, and will probably continue until the close of the present session. It has been demonstrated by the numerous witnesses who have appeared before the committee, that many readjustments are necessary. Voluminous evidence has been submitted to show that in many important items the rates of duty are inadequate to protect industry. It also has been stated by a number of representatives of the agricultural industry that a general revision of the tariff and readjustments upward will aid agriculture. It is therefore fairly certain that a new tariff law will be the major undertaking of the new Congress in special session.

Another major proposition to come before a special session is that of farm relief. The McNary-Haugen program is apparently dead, but the present indications are that a new farm-relief measure will be developed that will place agriculture in a better position to deal with its problems of over-production and marketing without special financial aid from the Federal Government.

Although we have been opposed to special sessions, if such a session is to be called, we believe that the sooner it convenes the better it will be for the business of the country. We do not share the fears that a special session will upset the business trend. The majorities in both House and Senate of the present Congress, and also the majorities that will prevail in the new Congress, are and will be actuated by conservative and constructive policies, designed to serve the best interests of the country. The interest that has been shown in the present tariff hearings on the part of both Congress and representatives of industry and the public, indicate a desire to work, and to arrive as quickly as possible at a constructive conclusion.

The special session may set a standard of performance in spite of the preponderance of evidence in history to the contrary.

Essential War Minerals And The Tariff

TWO courses are open to the Government in respect to the development and maintenance of domestic sources of supply of essential or so-called strategic war minerals such as tungsten, mica, antimony, mercury, chromium, nickel, tin and manganese. First, by the imposition of high tariff rates where there exists a possibility of developing a domestic industry; second, by the encouragement of efforts to devise and develop substitutes. The tariff may be as necessary to the second course as to the first. The tendency of past years to wait for a national emergency before encouraging the discovery, exploration and development of domestic sources of supply has been tremendously costly, both from the standpoint of Government expenditures and in the utilization and depletion of domestic resources of these minerals in an unnatural and uneconomic way.

Proper tariff barriers, based upon these considerations, make possible domestic mine development along economic lines; stimulate metallurgical research and the developmenet of processes for economic reduction and utilization of ores; and simultaneously encourage efforts for the development of substitutes. Even though it may be shown that the tariff duties imposed on these essential minerals would cost domestic consumers perhaps a total of $150,000,000 during the first 10-year period for which they should be effective, that amount is insignificant beside the billions that would otherwise be involved in the uneconomic development, utilization, and waste of domestic supplies in time of national emergency, unless these tariff barriers are erected. Furthermore, the cost of the tariff, while admittedly paid primarily by the manufacturing industries, who, it may be observed are the chief beneficiaries from the demands of a national emergency, is generally paid by the ultimate consumer, who, nevertheless, receives a direct benefit therefrom in steady employment, market for local agricultural products, and full pay rolls.

We do not favor a tariff that is certain to become solely a tax upon domestic industry and domestic consumers; but in every case where it appears that tariff protection will encourage investment, stimulate development, and bring about the invention and use of substitutes to supplement domestic supplies of essential minerals, it is believed that the cost of this protection will be considerably less than the ultimate cost to the people of the United States if this protection is denied.

Mineral Production In 1928

THE Department of Commerce has just released its figures upon mineral production in the United States for 1928. On the whole they are encouraging. Silver production shows the worst slump, while the copper industry shows the greatest increase. Gold production showed a steady decline, while lead and zinc held its own. Iron ore production was considerably increased. There was report of the building of many mills and of many plans for better production methods and increased production.

When mining slumps the whole structure of American business is menaced. The railroads depend upon this great industry to furnish them with 65 percent of their total freight tonnage; copper, lead, zinc and iron enter in an amazing proportion into the industrial fabric of our country. A gigantic load rests upon our mineral industries, in keeping the wheels moving.

When national and state legislatures fully recognize these important facts, much of the proposed legislation will be of a constructive nature and more effort will be made to help the industry.

The outlook for 1929 is encouraging, but the mineral industries must secure adequate tariff protection, must be relieved of unjust taxation, and must have cooperation instead of efforts to impede their forward march.

The Mining Congress Program

THE American Mining Congress, at its recent convention, passed resolutions on those problems it considered of major importance to the advancement of the mining industry. These resolutions urged revision and simplification of tax laws; greater tariff protection; exemption of the gold mining industry from the Federal income tax; defeat of proposals for the regulation of the coal industry, and increased appropriations for Federal and state bureaus of mines and other Government agencies engaged in promoting safety in mining, and in the discovery, development and utilization of new mineral resources. Upon the announcement of this program certain newspapers attacked it as unsound in that it asks for relief from excessive taxation and at the same time increased appropriations for those agencies representing it in the state and Federal governments.

Not in the way of defense of its program, but purely as a matter of information to those who hesitate to go beneath the surface to secure facts, the mining industry is contributing to the cost of government—Federal, state and local—a higher percentage of its net profits than any other industry. It is costing the mining industry more to comply with the Federal tax laws than any other industry on account of the intricate administrative provisions of law and procedure involved. It is entitled to relief from this situation.

The mining industry is a great basic industry, one of the principal sources of national wealth, and one that can not survive in many of its branches, or develop and prosper, without adequate protection against the pauper-wage mineral production of foreign countries. With adequate protection, the mining industry will continue to furnish in raw minerals and fabricated products 65 percent and more of the freight tonnage of our railroads, also local markets for the products of agriculture, employment and full weekly payrolls.

The gold mining industry is the only industry in which prices do not yield to the law of supply and demand; where wages and other costs have increased tremendously while the price of the product has remained stationary—fixed by law; where the Government sells the product to the trade at a fixed price so that there is no market and no competition in the trade and in the manufactures using the commodity. Since the Government deems it wise and necessary to maintain this policy with respect to gold mining, it should exempt that industry from the income tax.

Safety in mining, metallurgical research and experimentation, prospecting and exploration for new minerals and mineral deposits, continuous studies of economic conditions both foreign and domestic, and investigations of mining processes and conditions, and similar functions and duties that are reposed in Federal and state agencies, all are necessary to safeguard American industrial supremacy. And after all, the mining industry pays the bill.

Defeat of proposals for the regulation of the coal industry simply means keeping the Government out of business. Upon the maintenance of industrial freedom depend efficiency in management and production, and the operation of the law of supply and demand, under which our great domestic industries have been built up. Encroachment upon the freedom of contract, the rights of private capital and management to direct the employment of capital and business affairs and operation of business, would operate to stifle competitive conditions that bring about greater efficiency in production, lowered costs, increased productive capacity and all of the factors which have given to America higher wages, higher standards of living, and greater industrial development and expansion than are enjoyed by any other part of the world.

We believe the program of the American Mining Congress is essentially sound and in the best interests of the country as a whole as well as of the mining industry. This industry has not asked and is not now asking from its Government anything that it can do better for itself. When it is pointed out that agriculture, the only other basic industry comparable to mining, is receiving from the Government $33 for every one dollar received by the mining industry, it would appear that we are somewhat modest in our demands and just a little independent concerning those things we think we can do better for ourselves.

The Gold Miner

FIFTY years ago the announcement of the discovery of a gold producing vein would have been received with great eclat by the stockholders in any mining enterprise. Gold, the great wealth producer; gold the source of the amazing history of our boundless West; gold the base of our national finance—in fact, Gold, the King.

To those who are in a position to know, the plight of the gold miner is obvious. To the uninformed he is still King. The gold producer is bound by restrictions placed upon no other great industry. The price of his product is fixed by law. He can secure no open-market price, and he has no competitors. He is forced to produce and sell in a fixed market. But he is required to purchase his supplies in a varying market, one subject to all the fluctuations of industry generally. His costs have mounted steadily—labor, machinery, power, explosives, everything entering into production—and his market has remained fixed. The result has been that no new developments in the gold industry have been reported. Relief from taxation is one way in which the gold producer may be assisted.

Coal And The Public Interest

O A patient observer, the hearings on coal regulation which have recently occupied the time of the Senate Interstate Commerce Committee, have resolved into a repetition of basic claims. The same story has been told repeatedly before every investigative committee, before everybody discussing the coal situation, and at every conference called to settle coal problems.

The present bill, drafted by the United Mine Workers, proposing a licensing system of coal operations, regulation of wages and prices by a bituminous coal commission, and other regulatory features, has been ardently defended and vehemently denounced. But the sum total is the same. Nothing new has been contributed in the solution of the industry's problems.

The United Mine Workers insist that only by putting the Government in the coal business can human life be safe-guarded and the problem of over-production be solved. The operators have consistently stated their opposition to such a plan, and so far, after years of debate, their position has not been weakened by any evidence submitted by the opposition.

In the present effort of the politicians and the union, the operators, wholesalers, retailers and consuming public have unanimously taken the ground that Congress has "no more power to control coal, entering into the industry, than it has to control the fruits of California, the wheat of the West, the cotton of the South, the shoes of Massachusetts, or the woolen industries of other states." They have cited a large number of legal precedents to prove their assertions, and they have done it effectively. The very idea that one man's coal may be licensed to be mined and his neighbor's may not, is an invasion of the right to earn a living at a lawful occupation.

The coal industry has repeatedly made its case when attacked. It has done so in the present attack. It is certainly time that the public demand that this industry shall be permitted to work out its own salvation. It has been conclusively shown that the politicians can contribute nothing more substantial than further chaos.

Defining Public Interest

UNQUESTIONABLY the crux of the whole discussion before the committee hinges upon the interpretation of the question of "public interest."

The decision in the Wolff Packing Case vs. Court, 262 U. S. 537, quoted by many witnesses clearly defines this point, in the following language:

"It has never been supposed, since the adoption of the Constitution, that the business of the butcher, or the baker, the tailor, the wood chopper, the mining operator, or the miner, was clothed with such a public interest that the price of his product or his wages could be fixed by state regulation. * * * One does not devote one's property or business to the public use or clothe it with a public interest merely because one makes commodities for, and sells to, the public in the common callings of which those above mentioned are instances."

Equally, the following taken from the decision in Tyson vs. Benton, 273 U. S. 430, defines this public-interest question:

"A business is not affected with a public interest merely because it is large or because the public are warranted in having a feeling of concern in respect to its maintenance."

Our position in regard to the regulation by political commission, or otherwise, of the great natural resource industries of this country has been repeatedly presented in these pages. One fundamental principle we adhere to with tenacity: "Nothing should be done by the Government which the individual may do for himself." Whenever the people, free from all paternalism, and dependent solely upon their own resources and the natural working of the law of supply and demand, evolve their own channels of trade and the markets of their choice, business and Government function with the least friction. Any attempt to alter this condition disrupts the entire economic machine.

After all the evidence for and against the present attempt to ham-string the coal industry has been reduced to statements of fact, it will be found that aside from the desire of the union to again gain supremacy, the same conclusion must be reached: *Let the coal industry alone.*

Economic Reasons

THE Federal Railroad Administration furnishes an example of Government control where the inability of a Federal agency to efficiently manage a great industry has been thoroughly demonstrated. The transportation facilities of the country suffered heavily from the uneconomic and costly operation that prevailed under the railroad administration. It required several years under private management to restore railroad transportation to an efficient and economic and profitable basis. The cost of the Federal Railroad Administration was not an inconsiderable part of the tax burden borne by the taxpayers of the country during the last 10 years.

In discussing the economic question that would be involved in any plan for Federal regulation of the coal industry, it was pointed out that the law of supply and demand regulates the prices of commodities and services on the basis of their value, and also regulates the relative production in the various fields. Also, that profits and income on capital are regulated by natural laws in the same way that wages and commodity prices are regulated. For example, when there is too much capital invested in any field, prices and dividends decline. In the case of a shortage, they advance.

To quote G. W. Dyer, professor of economics at Vanderbilt University, Nashville, Tenn., who appeared before the Senate Interstate Commerce Committee: "To fix prices so that every coal company could make a stipulated dividend regardless of efficiency on the capital invested, would be the most stupid and unjust thing that could be done in regulating business. It would mean that the efficient would be docked and the inefficient rewarded." Furthermore, it would "repudiate the standard of value fixed by the law of supply and demand as applied to labor and coal mines and would substitute a standard fixed by the alleged needs of the employes." * * * "Whenever the standard of needs of the worker is introduced in any industry in place of the American standard of value, to the extent that the new standard increases the wage earners' compensation above what it would be under the law of supply and demand, the worker is permitted to use short weight in his exchanges and demand full weight from all who operate under the American standard. The direction of the economic process of production in private enterprises is not a proper function of government."

Excess Production And Government Commissions

TO ESTABLISH a commission for the regulation of the bituminous coal industry, either by a plan of licensing operators or by any other method that would destroy the right of any individual or group to engage in the industry, or that would in any way limit the right of private contract or restrict private enterprise and management in developing and carrying out any legitimate business policy or program, would be a dangerous precedent for the Government to establish.

As we have said repeatedly, we are opposed to any plan of Government regulation or control of industry that would place in the hands of any one man or group of men, who would constitute such a commission, arbitrary authority or dictatorial powers over private business and private rights. We are opposed to paternalism and the substitution of a bureaucracy for individual initiative. We believe any such legislation in the case of the bituminous coal industry is uneconomic, unsound, and unwarranted, even in the slightest degree. We feel confident that the plan now under consideration will be rejected. If ways and means can not be found by industrial leaders themselves to solve the problem of overproduction, it is not apparent how any Government agency could deal with the problem without violating fundamental principles of constitutional government.

Competency Of Private Leadership

THE principal metal-mining industries of the country have been brought out of the sluggish, unstable and depressed conditions that prevailed as an aftermath of the Great War. Our manufacturing industries have surmounted the economic difficulties of recent years in a creditable manner. The railroads have been re-vitalized, and evidence of the demoralized state in which railroad transportation was left by the Railroad Administration has been obliterated.

All of this and much more has been accomplished by the leadership in these industries, and proves that private management of industry is capable of solving the most difficult industrial and economic problems that may confront any industry.

Industrial leadership generally has dealt conscientiously and scrupulously with the problems of their industries, and has proved itself worthy of the public's confidence.

Our Growing Exports

THE enormous volume of our export business, and the continuous growth of foreign sales of our manufactured products, is a most favorable barometer of American economic stability. Foreign sales of manufactured products during 1928 totaled $2,258,000,000 as compared with $2,077,500,000 during 1927.

At the tariff hearings before the Committee on Ways and Means, on the metals schedule, the representative of the American Mining Congress was asked by Congressman Cordell Hull whether this country could not more easily dispose of its growing surpluses in certain commodities, "if we were just a little more liberal in our tariffs." The reply was made that this country is purchasing more foreign products and at the same time selling more American products to foreign countries than ever before in our history.

We believe it is a sound policy to purchase all non-competitive articles possible from foreign producers, and to protect American industry against competition in domestic markets from low-cost foreign production. That this policy does not in any manner materially interfere with the maintenance and expansion of our foreign trade is manifest from the Department of Commerce statistics on imports and exports since the 1922 Tariff Act became effective.

The Supply Industry

ADMITTEDLY coal mining has been in a bad way. The figures of production available from Government sources show that there was a decrease in production in 1928. Figures gathered by the American Mining Congress, and released through its Bureau of Mining Economics, show that the number of mines producing were materially reduced. But the fact remains that the coal industry for 1928 represents a tonnage of better than 500,000,000 tons. Quite a sizeable industry at that, and one that requires a vast amount of equipment and supplies.

In the regular operating costs, the average coal company spends about 10 cents per ton for its supply account. That means that during 1928 coal producers spent better than $50,000,000 in the purchase of supplies, which sum does not include whatever was spent for new equipment and charged to capital account. By supplies we mean grease, machine parts, electrical equipment, etc.

Little money was spent in 1928 for improvements, replacements or new equipment. But many companies laid their plans for the purchase of such equipment during the coming year. Inevitably the coal industry is approaching mechanization, and a considerable group of companies are now in the process of such reorganization.

It is well for the discouraged manufacturer of mining equipment to keep his eye upon that $50,000,000 business, and to watch closely the present trend in the industry toward mechanical production.

American Standards Association

THE elimination of waste in industry is no longer the cry of the economist alone. No longer does the practical official of our producing industrial units look askance at proposed reductions in sizes, shapes and designs. Industry itself has long since taken up the banner of its own salvation and effected it's organization for the formulation, and promulgation of standards. The American Standards Association, formerly the American Engineering Standards Committee, is the National standardizing body of industry. It has been recently reorganized and is, better than ever, in position to serve.

The mining industry has ten national standards, eight of which have been sponsored by the American Mining Congress. These codes are standards of both equipment and practice. Standards of efficient practice, and safe practice are just as important as standards of equipment. Recognizing this fact the A. S. A. has provided in its procedure for the following kinds of standards: American Recommended Practice, Tentative American Standard, and American Standard. The constant improvement in methods and machinery in the mining industry makes advisable the creation of tentative standards only. Standardization must point the way to improvement and should never retard it. This publication bespeaks for the Standardization Division of The American Mining Congress and The American Standards Association the continued support of it's readers in carrying on this increasingly important work.

Achievements of Government

DURING recent years, agencies of the government dealing with American trade, both in foreign and domestic fields, have been an important factor in the business progress of the nation. This is revealed in the annual report of Dr. Julius Klein, Director of the Bureau of Foreign and Domestic Commerce. Prior to 1923, the efforts of that bureau were devoted to the furtherance of export trade, but since that time its efforts have been expanded to include analyses of and cooperation in the problems of domestic business. The report shows that the efforts of the Bureau of Foreign and Domestic Commerce have been an important factor in the steady expansion of American trade at home and abroad.

During the past fiscal year, 800 firms and individuals in the United States reported known sales and savings directly traceable to the bureau's activities totaling $15,000,000, or an average of $18,000 per firm. The bureau currently serves about 22,000 firms. Three million inquiries and communications were handled by the bureau during the last fiscal period, nearly 10,000 each business day, in which some specific service was rendered to American commercial interests.

The importance of this work to the expansion of the export trade of this country, and to the economic well-being of the American public, is evidenced by the fact that from one-seventh to one-eighth of our total farm production is being marketed abroad, representing the output of 1,250,000 persons. Of the output of American factories eight or nine percent is exported, which represents the production of approximately 1,000,000 industrial workers. Notwithstanding the most vigorous competition, American exports of finished manufactures have steadily advanced until in 1927 they reached the huge total of $2,061,000,000, an increase of 4 percent over 1926, and fully 70 percent over 1921-22.

In domestic commercial activities, the bureau is engaged in a series of 9 regional surveys designed to reveal domestic buying trends, commodity preferences, and consumer habits; also, the influence of consumer differences upon trade in various sections, commodity movements, and the machinery of distribution and merchandising. Already the business public has recognized the need and usefulness of such information, and it is being enthusiastically received by those whose business success and prosperity depend upon efficient merchandising.

Such assistance to business from agencies of the Federal government is worthy of the highest commendation and is entirely consistent with the principles of a sound governmental policy. The example thus set by this important arm of the Department of Commerce furnishes a splendid pattern for the Department of Agriculture in its efforts to improve conditions in that industry, and the Department of the Interior in dealing with the disposition of public lands and other national resources. The Federal government is repaid many times over for the comparatively small cost for achievements of this character, and Congress can well afford to be liberal in making adequate appropriations for agencies that are functioning efficiently in bringing about the solution of problems of American business and industry that so vitally affect the nation's prosperity.

Copper In 1928

THE copper industry appears to have recovered entirely from the condition which depressed it after the close of the war. The manner in which the leaders of this great industry have brought it through without serious economic upheaval, is a tribute to them and to this industry which they have managed so efficiently.

During 1928, the price of copper increased throughout the year from a monthly average of $13.96 a pound in January, to $15.09 a pound in November and December. Demand, according to the *American Metal Market*, followed by the highest prices paid since April, 1923, brought about a largely increased production. Smelter production in December was 179,000,000 pounds, which is 27,000,000 pounds higher than the monthly average for the 11 months preceding. The 1928 production of copper was 10 percent higher than that of 1927, and is the largest peace-time production on record.

Predictions concerning the future of the copper industry may be safely predicated upon developments of the last year. The industry has reached a stage of prosperity and stability. No economic disturbance appears to be imminent. The copper mines are in a position to cope with the normal problems of development, production and marketing. It is one industry that is so well managed that not even the small producers or the high-cost mines are asking for aid or favor of any sort from the Government, nor is anyone outside the industry suggesting Government action of any nature. The copper industry has proved its ability to surmount the most difficult problems confronting it. It is earning its just reward.

The Flood Continues

A THIRD House of Technologists is the awe-inspiring title suggested by Dr. Glenn Frank, President of the University of Wisconsin, for a proposed advisory body to assist the United States Congress in legislating in behalf of the Nation.

Certainly no one will deny that Congress is faced with many harassing questions, upon all of which it is supposed to be well informed before it creates laws. Considering the large volume and diversity of subjects it must consider, it is indeed amazing that more unwise legislation is not enacted.

But would Dr. Frank's suggestion meet the situation. How many men would comprise this third House? And what right have we to presume that they, being mortal, will be gifted with some extraordinary sense that will make their judgment superior to, say, the ninety-six able men who make up the Upper House of Congress.

Economists and scientists are essentially theorists. They have a very definite place in our national life, but legislation affecting all industry must have a firmer foundation than theory.

In our opinion the creation of such a body would only complicate an involved situation. Industry is organized to present to Congress the facts concerning it. These facts have back of them the real needs of industry and no group of men, however erudite, can hope to acquire the necessary experience and understanding to recommend legislation for more than a very few of the gigantic industrial problems of the Nation.

There is available, or can easily be made available, to any member of Congress today complete information upon the requirements of any industry. The creation of such a body as that suggested, while creating some mighty fine political jobs, would only complicate and in a measure duplicate, present machinery.

The INTER-RELATION *of* MINING, AGRICULTURE *and* PROSPERITY*

By HON. SCOTT LEAVITT †

Substantial Percentage Of Products Of Mines Go Directly Into Agriculture, And A Larger Percent Reach The Farmer Indirectly—Big Problem In Common Is That Of Marketing, Which Includes Transportation

WE have had within the last few months a statement coming from one of the foremost mining engineers of the world which shows us that a mining engineer can very fully understand the needs of agriculture and can recognize that the two are interrelated and that the prosperity of the one depends on the prosperity of the other. I refer to the fact that in his speech of acceptance that great mining engineer who will be the next President of the United States, and who had the advantage of being born on a midwestern farm to give him a knowledge of agriculture as intimate as his knowledge of the mining industry, stated that in the coming administration the foremost problem to be solved is that of agriculture. There is a statement from a mining engineer that gives us assurance that there is understanding of the fact that those two great industries are related.

To begin with, without going into any great number of figures or statistics, I was greatly struck, in getting together material for this talk, to find that in 1926 4 percent of the steel used in this country was used in the manufacture of farm machinery. And in 1927 that percentage of steel used in the manufacture of farm machinery had increased to 5.1 percent; a rather large increase in percentage in the period of one year. I am led to believe that 1928, when the figures are gathered and completed, will show a similar increase. Of course, that is only one feature of the products of the mines that go into the manufacture of material to be used by agriculture. These same figures showed me that 4 percent of the iron and steel produced goes into the manufacture of containers and, of course, those are used to a great extent in the canning of the products of agriculture.

Fourteen and one-half percent of the steel and iron produced is used in the automobile industry. One-third or more of our entire population resides on farms and are using automobiles and trucks, so

* Presented to Thirty-first Annual Convention, The American Mining Congress.

† United States Congressman for Montana.

that a large percentage of the trucks and automobiles that are used are used by the farmers of the country. In fact, over 5,000,000 trucks and automobiles are used in agriculture directly. And those are in addition to the trucks used commercially in the transportation of farm products, trucks not owned by the farmers themselves. A very considerable extent of that product of the mines goes directly to agriculture.

I was very greatly interested in working out other figures with reference to these matters to find the relation between agriculture and the oil industry. While I could not find any accurate data directly on the subject, I came to the conclusion that it is safe to say that 2,000,000,000 gallons of gasoline are used each year by the American farmers. Perhaps 800,000 gallons of lubricating oil are used directly by American agriculture.

Similar figures can be given in connection with the copper industry, and many other metals and mine products.

That shows what the prosperity of American agriculture means, regarding it as one-third of the population of our country, and how necessary it is to maintain its high purchasing power.

Now we can reverse that. We can show just as fully this fact, that the prosperity of the mining industry, not only as it has to do with the management and employers, but particularly as it has to do with the prosperity of the workers in the mining industry, is an essential thing to the prosperity of American agriculture. While the number of people engaged in the mining industry is not as great as the number directly dependent upon agriculture, the figures are, to a great degree, comparable. The group of people in our country who are dependent upon mining for their livelihood is large enough to afford a very considerable market for the products of the farms.

Our population, within the United Sates, consumes practically 90 percent of the products of our farms. In other words, 90 percent of the products of our farms is consumed by the people of the United States themselves. So that the sustained purchasing power of any great group, like that interested in the mining industry, is likewise essential to the agricultural industry.

But there are some other things that, by a close study and analysis, will show a close community of interest between those two industries. Mining and agriculture are the outstanding producers of raw materials in this country. It is true that there is a very essential difference. The products of the mines are not replaceable, as are the products of the farm. The farmers are able, by careful study, and by scientific methods, and by better management in their production, to continue indefinitely the bringing of their products into the market. In mining we have a very different situation, in that the natural resources upon which it depends can be exhausted. But I was greatly interested, in thinking this subject out, to find that in both of these industries, scientific study and research are being carried on for the conservation of those resources, to make the mining industry go far into the future, as well as to conserve the strength of our soil to bring about a greater agricultural production.

Hon. Scott Leavitt

As between the two industries, their relationship, leading out into the matters of production and consumption, we have an additional problem in common, and that is the matter of marketing. I remember very well, in discussing with some of the officials of the American Brass Company, out in my home town in Montana—I live in Great Falls, where we have a great copper smelter and a great zinc smelter—that I found that while we have there the raw materials that go into the fabrication of brass, we are not able to fabricate it profitably there on the ground. I found that the difficulty was largely one of transportation costs to the points where we have to go to the markets. We have exactly the same situation with reference to our agricultural crops in that great Rocky Mountain section. We can produce the best wheat in the world; we can produce as good flax as is produced anywhere, and we find ourselves handicapped in the profits from their production by the fact that we have this same high cost of transportation.

We are interested, then, in the study of the inter-relation between these two industries, particularly in the sections of the United States we call the Inter-Mountain country, in working out the transportation problems that are handicapping both. We have the raw materials in the ground in that western country that could be manufactured if our transportation problems could be satisfactorily solved. I have in mind two great ranges of mountains, and their deposits of iron ore. The geologists know the ore is there. The manufacturers know it is there. There is no question about that. The question of having it mined and brought into the markets is at this time, I am told, a matter of transportation; and it is the high cost of transportation that is preventing the bringing of it into the markets.

These things run hand in hand. And a clearer and a closer understanding of the problems of the two industries by the leaders in the two industries that the problems are sufficiently similar to be of interest to both ought to enable us all to get together on a program that will bring about results beneficial in both directions.

In my experiences in the western country I have had close touch with the homesteader, the man who goes out full of hope and enthusiasm, goes out and takes up land under the land laws of the United States, and who envisions in that piece of raw land and its resources the development and the growth of a home. He sees the development of a civilization. And he has the same quality as the old prospector, except that he becomes fixed to the soil. He is likewise a builder, a hoper, and a dreamer. Such people built that western country of ours. They are the two who have built the mining and the agricultural industries of this country, and they are both individualists.

I talked to a group of farmers in my country a few months ago. We were talking about the things that might be done for agriculture in the way of legislation, and one of the leaders came to me and said, "These things are difficult, because we are individualists; if we were not individualists, we would not be farmers; we would be working in groups, and letting somebody else think for us. But because we are individualists each man likes to have his own farm and work out his own problems on that farm, which is a small domain to him."

The same thing is true of the growth and development of the mining industry. Individualism is at the base of the urge that sends the prospector out, who has for his later prototype the mining engineer going out into the far places of the earth, reading the earth more clearly than the old prospector did, but with the same compelling urge which takes him all over the earth. He is the man who pioneers our mineral resources into the growth and the wealth of our country.

And that individualism seems to me to be an essential thing to maintain in both of these two industries, an individualism that was so well stated as a fundamental of our American life by the speaker at the banquet last night, and that also was so well brought out by that foremost mining engineer who will be the next President of the United States, in his acceptance speech.

(*Continued on page* 98)

MINING *and the* MINING SCHOOL*

By C. H. C. BRADEN †

Colorado School Of Mines Has Distinguished Record—What Mining Engineer Has Contributed To National Progress—Graduates Of This Mining School Found Wherever Great Mining Enterprises Exist

THE world's progress today is dependent upon the expansion of man's knowledge of engineering and his increased ability to apply this knowledge toward the development of the world's resources. Mining is the basic industry of the modern system, for without metals, without coal and petroleum, without a knowledge of how to obtain these from nature—in short, without mining—the modern age of machinery and power could not exist.

Men began to recognize the usefulness of certain metals at the end of the Stone Age, and, as time went on, employed these metals more and more in the advancement of civilization. The rapid development of the sciences in the eighteenth century brought about the realization that if the valuable minerals concealed in the earth's surface were to be recovered, refined, and utilized efficiently, it would be necessary to have a knowledge of engineering, and, therefore, mining engineering schools were established. The first groups of such institutions were founded in the eighteenth century as follows: The Sachisariska Bergakademie at Freiberg, Germany, in 1765; the Leningradsky Gorny J. Institute (Berginstitute), in 1773; and the Ecole National Superilare des Mines, Paris, 1782. The latter part of the nineteenth century saw the founding of a larger group, beginning with the Royal School of Mines, London, in 1851, followed by the Columbia School of Mines, New York, in 1864; the Missouri School of Mines, Rolla, and the Colorado School of Mines, around 1870; and the Michigan College of Mines, Houghton, in 1885. Numerous other schools of mines and departments of mining engineering have come into existence since. Among these are the state-supported Schools of Mines of South Dakota, New Mexico, and Montana. There are departments of mining engineering at the Universities of California, Arizona, Utah, Nevada, Idaho, and Illinois; the University of Pittsburgh, Carnegie Institute of Technology, the Massachusetts Institute of Technology, Case School of Applied Science, Stanford University, and others.

The Colorado School of Mines was established about 1870, although the official date is given as 1874. In 1870 the Colorado territorial legislature appropriated a sum for the purpose of founding a school of mines. In various other ways the territorial government aided in the starting of the school, but did not take over the government of the institution until 1874, at which time the name "School of Mines" was given and later changed to the Colorado School of Mines. The discovery of gold in Colorado undoubtedly had much to do with the establishment of the School of Mines, and for many years special emphasis was laid upon instruction relating to the precious metals, but later more attention was given to the baser metals. With the knowledge that Colorado probably has the greatest coal reserve of any state in the Union; that it has enormous oil-shale deposits, and important, though only partially tapped, petroleum reserves; that it has extensive wealth in common and rare metallic and nonmetallic minerals, it is realized that the Colorado School of Mines has before it today a field broader and more important than ever before.

At the present time, the School of

* This is the second of a series of articles on the leading mining schools of America.

† Director of Publications, Colorado School of Mines, Golden, Colo.

Guggenheim Hall, the main building on the Colorado School of Mines' campus, the gift of ex-Senator Simon Guggenheim, erected in 1906. The view to the right is looking north from the steps of the building. Castle Rock, one of the landmarks for the early gold-seeking pioneers, is seen in the background.

The Experimental Ore Dressing and Metallurgical Plant at the School of Mines. This modern milling plant is only eight city blocks from the main Administration building.

A corner of one of the chemical laboratories at the Colorado School of Mines. A thorough course in chemistry is required for all degrees at the School of Mines.

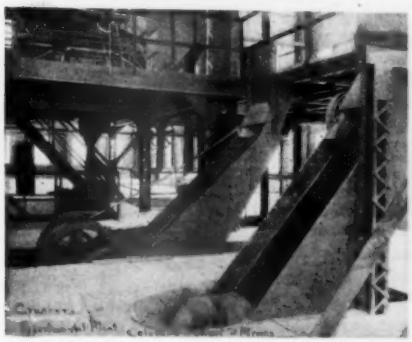
Mines is the largest institution directing its entire energies to the training of engineers for the mineral industries. While departments of civil, electrical, and mechanical engineering must be maintained to properly train the mining engineer, no degrees are given in these branches. The degrees given are: Mining engineer (E.M.), metallurgical engineer (E. Met.), petroleum engineer (P.E.), geological engineer (Geol. Eng.) with options in fuel and ceramic engineering. Graduate courses are offered to those who desire to specialize in subjects relating to any of the above branches. The curriculum was made with the idea that all engineering is based upon mathematics, chemistry, physics, design and expression (English); that it must have as part of its structure mechanics, strength of materials, thermodynamics, hydraulics, and graphic statics. The structure must be completed with a thorough course of economics, and, finally, there must be instruction in the relationships between the specialized subjects taught and with industrial production.

Besides the facilities for instruction, the Colorado School of Mines maintains a thoroughly equipped experimental plant under the direction of experts. Experimentation is undertaken upon all types of metallurgical and mining problems, and includes extensive research on flotation (both theoretical and practical) and other types of concentration, as well as research on the problems of crushing, sizing, roasting, smelting, leaching and electrolytic precipitation.

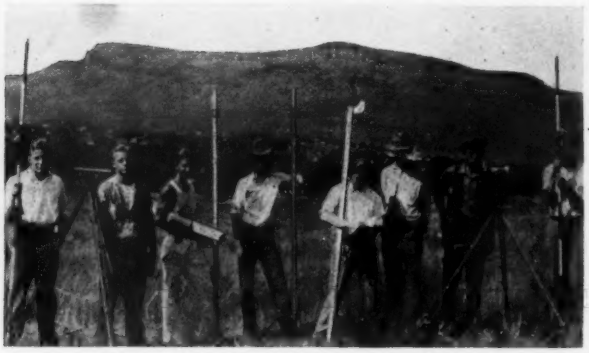
The Colorado School of Mines, ever a pioneer, recently has made available instruction in geophysics. The courses offered include, besides those in general geophysics, work with the torsion balance, magnetometer, seismograph, and apparatus used in electrical methods of prospecting. In this way students are afforded an opportunity for advanced study in a field destined to give a more quantitative aspect to the subject of geology.

The School of Mines is admirably located for conducting field courses, and these are considered essential to a well-balanced training in engineering. The six weeks immediately following the closing of the regular school year are devoted to these courses. Plane surveying is conducted in and around Golden; mine surveying is given at the School of Mines mine at Idaho Springs, where civil engineering problems are also undertaken; and the geological field work is carried on at various places in Colorado, New Mexico, and Arizona, with ample time for studying sedimentary and igneous rocks, oil structures, ore deposits, and various other phases vital to the geologist.

Mining men have always been an interesting group with their many experiences and adventures in the various countries of the world, with the spirit of the explorer in their make-up and the blood of the pioneer flowing in their veins; and, in the same way, the true students of mining engineering are imbued with an adventurous spirit and a determination to conquer. Mining engineers have devoted their lives to the great task of developing the natural resources of the uncharted corners of the world. These engineers, in response to the demands of their profession, find it at times necessary to face hazards that would chill the blood of men who do not respond to the urge to build. Surely no other profession could give a man a freer hand to



From left to right—Grizzlies and coarse crushers on the second floor of the Experimental Plant; Office building of the School Mine at Idaho Springs, Colo., and one end of the electro-metallurgical laboratory. All candidates for the degree of Mining Engineer are required to spend six weeks at the School Mine doing practical mining work



A party of Colorado School of Mines' students at work in the field.

go wherever he would and engage in work demanding a mixture of the explorer, the pioneer, the economist, and the specialized engineer. No profession has been of greater service in the past than that of engineering, and no period of civilization has been more dependent upon the mining engineer than the present age of power.

The Colorado School of Mines has since its founding graduated 1,480 men, and has during the same period given instruction to nearly 5,000 students who received no degrees. Virtually every state in the Union and many foreign countries are represented among its graduates. Colorado School of Mines men are found in every important mining camp in the world. In the present student body there are represented 38 states and territories and 12 foreign countries. The cosmopolitan nature of this body of young men has features to recommend it. World affairs are better understood through association with men from many countries of the world. School of Mines men have need of such understanding, for they have attained prominence not only in active engineering fields but also in international connections, where they have held and are still holding important positions in the direction of government affairs.

The average visitor, driving through the campus, admiring the sloping lawns and the ivy-covered buildings of the Colorado School of Mines, may see it as just "another college." But nothing could be further from the actual truth, because that which impresses one most upon close contact with "Mines" is the distinctive nature of this particular school. This average visitor is not aware of the pioneering spirit of the Colorado School of Mines; he can not feel the subtle influence of an adventurous calling that is forever exerting a force there; and he can not realize the significance of a cosmopolitan student body. Alumni can not be marshaled out on the lawns for review, each carrying a placard telling of his engineering achievements in many countries; and the valuable contributions of research resulting from long, tedious hours of labor can not be posted on the outside walls of the laboratories for the visitor to observe. These things this average visitor can not see as he views the campus and the buildings. It is, however, in these subtle ways that the Colorado School of Mines has in the past contributed its mite to the betterment of the engineering profession and of all mankind, and in these same subtle ways will it continue in the future to make its contributions. The Colorado School of Mines has ever been unique, and there is every likelihood that it will never lose its distinctive nature.

MINING, AGRICULTURE and PROSPERITY

(*From page 95*)

Those are things that seem to me to be essential in the interrelation between these two great industries, the one depending upon the other for its prosperity, and the well-being of our institutions depending upon the keeping secure in the effort, the idea which enables a man to take hold of the resources of this land, with his energy and skill, and reach out as far as his energy and skill will allow him to go. Out of such an idea we have the combined strength of the United States, and all that is worthy of maintaining.

We have a greater hope, in my view, for the interrelation of these two great industries in the next few years than in any time in the past.

METHODS AND COSTS OF MINING MAGNETITE

A report on the method and cost of mining magnetite in Mineville, N. Y., just issued by the United States Bureau of Mines, is the first of a series of papers to be issued dealing with mining methods and costs in the metal mines of the country. These papers are being prepared by officials and engineers of mining companies, in cooperation with the Bureau of Mines, and in accordance with an outline prepared by the bureau for the purpose of securing uniform and comparable data.

After a sufficient number of these papers have been prepared it is planned to issue a series of bulletins dealing separately with each mining method and with particular phases of the general subject such as "Sampling and Estimating," "Exploration and Development," "Comparison of Mining Methods based on Labor Efficiency and Cost Data," "Drilling and Blasting Practice," "Wage, Contract and Bonus Systems in Metal Mines of the United States," "Shaft Sinking Practice," "Underground Transportation," "Mechanical Loading and Hauling," "Underground Mine Support," and "Ventilation in Deep Mines."

Each mining district presents different problems as to the methods of ore extraction and underground support, which are dependent upon the type of the ore deposit and the character of the inclosing rock, states A. M. Cummings, one of the consulting engineers of the Bureau of Mines, in the report, designated as Information Circular 6092. Mining costs, however, depend largely upon the efficiency with which the methods employed underground are applied as well as upon the selection of the method best adapted to the physical conditions.

The town of Mineville is situated in the Adirondacks, five miles west of Port Henry on Lake Champlain. Records show that iron ore was produced in the Mineville district during the American Revolution. As far back as 1849 Witherbee, Sherman and Co., owners of the present mines, started operations which have been continuous with but small periods of suspension up to the present time. The relative importance of the district is indicated by its vast production, which has amounted to approximately 45,000,000 tons.

The Mineville district is situated within the area of Adirondack gneisses and Granville limestone. This area is penetrated by small masses of an intrusive rock (gabbro), and the principal ore bodies are adjacent to one of these masses. Both to the north and west is an extensive mass of gabbro which measures 100 miles across in an east and west direction. The gneissoid rocks are classified as pre-Cambrian, and the occurrence of limestone would indicate that they are of sedimentary origin. Trap dikes occur, crosscutting the gneissoid rocks as well as the magnetite beds. Faults and much folding are prominently disclosed in the underground workings.

The report discusses methods of exploration, early and present mining methods, drilling and blasting practice, loading and tramming methods, hoisting and pumping methods, labor efficiency, the working of the wage, bonus and contract system, and mining costs.

Copies of Information Circular 6092 may be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D. C.

INDUSTRY'S RELATION *to* HUMANITY*

By HON. JAMES J. DAVIS †

Good Will And Cooperation Greatest Factors In Problems Of Industry—Improved Machinery Bringing About Reduction In Workers And At Same Time Establishing New Industries—Problems Of The Mining Industry Discussed

WE ARE living today in an age of transition, in an age when it seems seldom advisable to invoke, at least in economic matters, the spirit of the past. Men and women, employers and workers, are taking it upon themselves to unburden their minds and speak out.

Now, a great deal needs to be said in regard to the relations between employer and worker, and much in regard to the modern development of business. More than 1,000,000 persons, according to the last census, are employed in the mining industries of our country, and of this number 147,372 are employed in mining anthracite coal, their salaries and wages amounting to nearly a quarter of a billion dollars.

Nearly 600,000 were employed in mining bituminous coal, and to these approximately $920,000,000 was paid in wages and salaries.

In the mining of metals 131,000 were employed, whose wages and salaries approximated $230,000,000.

I doubt if there has been any increase in the number employed in the anthracite and metal mining industries since the time the last census was taken, since labor-saving machinery has supplanted many workers here as elsewhere. And I am convinced that conditions in the bituminous fields have been such that a considerable reduction in the number of persons employed will be found to have occurred.

Now, it seems to me that the entire mining industry of America is producing too much, and the competition in it is disastrous. Unreasonable competition, in fact, appears to have paralyzed some parts of the mining industry in respect of both metals and coal. And is it not true that this frightful competition has had a tendency to lower the standard of living, not only on the part of the workers employed but also of those who have invested their money in mining industry?

I know that the adage which tells us that competition is the life of trade is an old one, and doubtless it was true in the day when the phrase was coined, but time has a habit of turning our old truths into falsehoods, and I think that in the matter of coal its falsehood has become clearly pronounced. There has been altogether too much disastrous competition here, and its evil effects are clearly apparent. A certain amount of competition is doubtless a stimulant, and a stimulant is sometimes needed, but the coal industry has been so overstimulated that it now resembles a man in the condition known, in slang phrase, as having "a jag on." Overcompetition in this industry has made not for prosperity but for adversity.

It is not possible for American coal to compete much with other coal in the markets of the world, because outside of America wages are low. Real wages in a large American city are twice what they are in London, three times what they are in Paris, and more than four times what they are in Brussels, Rome and Madrid. It is the high wage paid to American labor that has given us the greater amount of prosperity, while Europe and Asia are poor because the workers are not an adequate factor in the economic life of their respective countries. But even in America there are some industries where the wage paid is so low that the workers have but slight purchasing power, and where this occurs but little of the productive power of America finds a market amongst them.

The only prosperous industries in America are those which pay good wages and are profitable to the owners. They are the only ones that will ever be prosperous. But even some of these industries which, in their relation to other industries, sin against their own light. Take some of the industries producing luxuries, or semi-luxuries, for example. We see these industries striving to cheapen or break down the price of coal. The men who own and operate these industries have but one thought in their minds, and that is how to buy coal and other materials as cheap as possible. They forget that the purchasing power of the men who produce the coal is, or should be, an important factor in our economic life. They forget that the man who receives only a bare subsistent wage is unable to buy the luxuries, or semi-luxuries, that they produce. They want prosperity for themselves, but they have not yet learned that they can have the highest prosperity only when the condition of prosperity is found everywhere.

Selfishness in the long run—and the longest run is never very long—always defeats itself. History is eloquent in its tales of the despair that overtakes selfishness in the end.

We have in America industries that are strong for protection; that is, protection for themselves. I have one such industry in mind at this moment. It says that it is unable to compete with the low wages paid to the workers of Europe. Now, that is true; but I am informed by a very reliable coal operator that this very industry I speak of, which is so anxious to be protected against the cheap labor of Europe, is always doing its level best to obtain the

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† Secretary of Labor.

coal of America at prices which prevent the operators from making an insignificant profit, or no profit at all. This selfish policy is sure to defeat itself in the end.

The first thought of every employer ought to be the wage paid to his men. He should consider how can pay them good wages. There should never be any reduction in wages in order to lower costs—to lower costs the employer should look to new machinery and to greater efficiency in business management.

The employer who professes to believe in a protective tariff, yet insists on buying his supplies at disastrous prices, is saving himself from foreign industries yet taking advantage of American industries.

Let us look at what has taken place in mining. There is a metalliferous mine which sent a certified statement to the Department of Labor last year which showed that 10 years ago the mine produced 610 pounds to the man, and that it is now producing 1,680 pounds to the man, yet the firm has reduced the number of its employes from around 650 to 280, and expected to drop an additional 180.

If this country is to retain the prosperity that it has enjoyed, still more if it is to increase in prosperity, the irreducible minimum of workers remaining, after the introduction of new labor-saving machinery has done its utmost, must share in the most recent economic gains that have accrued from this source. The hundred workers still needed to carry on the mechanical work of the aforesaid mine should receive, for business reasons if for no other, their proportionate share of the enhanced profits that they may buy the products which the great industrial machine turns out.

There are two P's in business—one of them is Prosperity, the other is Poverty. The last P we can eliminate to advantage; the first P should be our abiding possession forever.

In 1912 approximately 166,000 men were employed in metal mining; last year the number was 120,000. About 90,000,000 tons of ore were mined in 1912 and 150,000,000 tons in 1927. This increase in productivity is in part due to improved machinery and in part to different methods of mining. It is estimated that by using the improved rock drills ten times as much drilling can be accomplished as by hand. Haulage has been increased in the mines to a great extent by using electric or other dinky engines. It is estimated that about ten times as much ore per man can now be moved in the mine as fifteen or so years ago.

Loading machines are also used in metal mines. With such machines two men can load about 125 tons in an eight-hour day, while one man loading by hand will load from 15 to 20 tons.

Power drills are used almost universally, and were the drills to be eliminated not enough men could work in the mines to produce the amount of ore now taken out when drills are employed.

You know, of course, as well as I do, that the machine has had its unfavorable critics as well as favorable ones. John Ruskin wanted to see all of our labor-saving machinery wiped out of existence, and Samuel Butler, in his "Erewhon," has described an imaginary community which had carried out Ruskin's idea. Even John Stuart Mill, the distinguished political economist, was not certain that the machine had been an unmixed blessing, though his reasons for thinking so were not the same as Ruskin's. Mill's grievance against the labor-saving machine was that the labor-saving machine had never lightened the burden of anybody's toil, and at the time when he wrote he was probably right. Indeed there is a good deal of reason for thinking that for many years labor-saving machines increased the toil of the workers. That is not true today; the very opposite is true. The machine is conferring leisure upon the workers themselves. But unless we control machinery and its tendency to overproduction, my friends, it may give us too much leisure altogether in the unpleasant form of unemployment.

The industrial revolution solves some of our problems, but it has also given us new problems to solve. The machine is capable of producing goods, and it tends to become more and more automatic, so that men are beginning to wonder whether a time is not destined to arrive when human labor will become almost, if not quite, unnecessary. When one bears in mind that there are even now cotton looms which work so nearly automatically that one weaver can tend 36 of them, and that the best-equipped plants are employing these looms, it is seen that the machine is producing a problem that is going to require all the brain and heart we possess in order to settle it, and settle it right.

If we keep on increasing machines and adding to our production, a theory will develop which holds that because we can supply our markets in six months with all that is needed, the industry can be shut down for the other six months, which would mean a three-day work week. Indeed, eventually we may reach a stage where a week's work, or even less, may supply all our necessities.

I do not mean, either, that modern machinery and its economic effects affect the employer only. The worker must know how to adapt himself to it. The improvement and spread of machinery is inevitable, and he must fit it into his life and thought. Especially must he make the most of machinery, for it produces the wealth from which all wages are drawn.

Our larger industries today are taking on youth. They have a very hard time to keep employed their own workers who are approaching the 50-year mark. When a man of 50 presents himself at a factory gate in search of a job he is too often met with the statement that no work is available for one of his years. And often this jobless man is the victim of his own conservatism. A new machine was placed before him, but he preferred the old hand ways, and a younger man replaced him.

I have been told of an instance of this kind in the records of the Bureau of Labor Statistics, which makes investigations into labor conditions throughout the country. The day is past when a pencil plays an important part in a business concern. The work is done with adding and computing machines, which multiply, divide, subtract, and measure. In fact, they do about everything but talk. When these machines were brought into a certain office, the older men said they would stick to the pencil. The result was that younger men got the new and important jobs.

The wise thing for the worker, and especially the older worker, when the machine comes into the office or the factory, is to seize it and operate it, and make sure for themselves continuation in the job. It is better to send the younger men into new varieties of work, and let the older stick to the old jobs. I believe, too, that the older man makes the better and more faithful worker.

This is temporizing with the rapid advance of machinery, nevertheless. If it is one day to do so much of our work that human workers become increasingly unnecessary, and we all have unlimited leisure, it may seem very fine on the surface. But it ought to be apparent to the veriest tyro in economics that when that happens, or unhappy day arrives, the purchasing power of the masses will be gone. The warehouses of the land may be bursting with goods, with but few equipped with the means to buy them. I say we must watch this spread of machinery or it will fill the market with goods and empty the market of buyers.

Neither is machinery the only thing tending to deprive of buying power that greatest customer in our market—the millions of workers. When I was on a steamer going to Europe last summer, I met a man who said that he paid 50 cents an hour to the workers in his factory here, 25 cents in Liverpool, and he was going to Germany where he could buy labor for 17 cents an hour. He told me that he was not going before congressional committees to ask for a tariff—he was going to use (*Continued on page* 105)

The OUTLOOK *for* COAL*

By GEO. H. ASHLEY†

WHAT Has Happened, Is Happening And Is Likely To Happen, In The Future in Coal Production—An Interesting Analysis Of The "Coal Situation" And A Prediction As To Its Future.

ANY prediction to be worth while must be predicted on an adequate knowledge of the past and on the trend of events at the present time. It is, therefore, desirable or necessary that we first understand just what has happened in the past, and what is happening in the present. Regarding the past, abundant figures are available if one will take the pains to dig them out. Especially for the period since the war. Record of the past 10 years holds the key to the next 10 years.

It is not my purpose to burden you with many figures, though a few are given in the form of tables. In wading through figures, as in wading through water, we are suppose to leave behind what one wades through; at the same time we are supposed to have caught some fish and to have brought them out with us. That all is not well with the coal industry is too apparent to need comment. Over-production is usually assigned as the cause of the coal industry's ills. The underlying difficulty, however, is a too-readily-available supply.

Granting that something has happened to coal, just what has happened, what is happening, and what is likely to happen in the future is the subject of this talk.

First: Where were we going, and where are we now? Had the production of coal continued to increase at the rate at which it had increased up to 1910, the production in 1927 would have been between 1,525 million tons and over 2 billion tons, according to where we begin to straighten the curve. One hundred years ago coal production was increasing at the rate of 500 percent in each 10 years. By 1850 it had settled down to a 100 percent increase for each 10 years. From 1850 to 1910 the average gain was over 100 percent each 10 years. The production in 1910 was over one-half billion tons. At the rate of 100 percent gain the production in 1920 should have been over 1 billion tons, and in 1927 over 1,700 million tons. The gain from 1900 to 1910 was at the rate of 88 percent for the 10 years. If that rate of gain had been maintained the production in 1927 should have been over 1½ billion tons. The actual production was 600 million tons. Surely something has happened to coal.

Second: What has happened to coal? Why should the production today be less than it was 10 years ago when for 100 years coal had doubled production every 10 years? Taking the lower figure, we are faced with finding an explanation for the loss of two-thirds of our expected coal business. Some job! In other words, who got the business equivalent to the production of 900 million tons of coal?

There are three thieves that have broken into the house of coal and stolen its trade. First is a lower rate of population increase; second, the efficiency engineer; third, a sudden expansion in the use of competing fuels and sources of power.

(1) *Population.* From 1830 to 1880 the population of the United States increased four times. (Table I.) Had it increased as fast during the following 50 years, from 1880 to 1930, it should have been 200 million by 1930. A little study shows that of the increase in coal production in the last century, practically one-third was due to increased population and two-thirds to increased use per capita. The rate of increase in population from 1910 to 1920 was less than one-half of the average of the last century. I have estimated that if the old rate had been maintained it should have made a difference of about 66 percent in the present demand for coal. If we start with the population in 1910 and the rate of growth between 1900 and 1910, our present population is about 18 percent below what it would have been if the earlier rate had continued.

(2) *The efficiency engineer.* Leaving the actual computation and figures used as a basis therefor to the footnotes, I have estimated that increasing efficiency in the use of coal has cost the coal trade over 285 million tons a year. That is a conservative figure, as we have little reliable information to base accurate calculation on before 1917. Since that time accurate figures have been kept for certain uses, such as the railroads, public utilities, and by-product coking. Possibly figures for earlier dates are available if one could dig them out.

For example: The public utilities (Table II) effected a saving in the use of coal in the seven years from 1919 to 1926 of over 31 million tons. If to this we add 19 million tons to take care of the estimated savings before 1919 the total loss to the coal trade from this source amounts to 50 million tons. The railroads (Table III) used 26 percent less coal per 1,000 ton-miles in 1927 than in 1917, an estimated saving and loss to the coal trade of 43 million tons. Add 31 million tons to cover estimated previous savings gives 75 million tons less coal used by the railroads than would have been used on the old basis. I estimate that the increased use of by-product coking has displaced the equivalent of 16 million tons of coal. (Table IV.) Of this, 3 million tons are displaced because of the greater efficiency of the process itself; 10 million tons are displaced through the use of the surplus gas produced in the process; and 3 million tons due to the displacing of coal by the burning of the tar obtained in the process, or 16 million tons total. I have estimated that the drift from homes to apartments based on recent figures, has cut at least 10 million tons off the demand for household fuel. (Table V.) It may be considerably more than that. Improvements in the production of pig iron are said to have made a re-

* Given in brief at meeting of Coal Mining Institute of America, Pittsburgh, Pa., December 12, 1928.

† State Geologist of Pennsylvania.

TABLE I—U. S. POPULATION GROWTH IN PERCENTAGE

Year	Population	Increase	Per cent
1790	3,929,214	.....	....
1800	5,308,183	1,379,269	35.1
1810	7,239,881	1,931,398	36.4
1820	9,638,453	2,398,572	33.1
1830	12,866,020	3,227,567	33.5
1840	17,069,453	4,203,433	32.7
1850	23,191,876	6,122,423	35.9
1860	31,443,321	8,251,445	35.6
1870	38,558,371	7,115,050	22.6
1880	50,155,783	11,597,412	30.1
1890	62,947,714	12,791,931	25.5
1900	75,994,575	13,046,861	20.7
1910	91,972,266	15,977,691	21.0
1920	105,710,620	13,738,354	14.9

TABLE II—LOSS OF COAL TRADE DUE TO INCREASED EFFICIENCY IN USE

Public utilities, producing power. (1919) one kwh. required 3.2 lbs. of coal; (1927) one kwh. required 1.83 ibs. of coal. Difference, 75 percent.

	Tons
Coal used in 1927	41,888,000
75 percent saving equal	31,406,000
Est. for gain before 1919	18,594,000
Total	50,000,000

TABLE III—RAILROADS

(1917) 1,000 ton-miles require 176 lbs. of coal; (1927) 1,000 ton-miles require 131 lbs. of coal. Difference, 26 percent.

	Tons
Est. coal used (28 percent of total)	168,000,000
26 percent saving equal	43,680,000
Est. saving before 1917	31,320,000
Total	75,000,000

TABLE IV—BY-PRODUCT COKING

1925	
Coal used tons by-product	57,109,651
Coke made tons by-product	39,912,159
Yield percent	69.9
Coal used tons beehive	17,422,581
Coke made tons beehive	11,354,784
Yield percent	65.2
Saving percent	4.7
1927	
By-product coke made tons	43,921,000
Est. coal required (69.9%) tons	63,000,000
Est. saving (4.7%) tons	3,000,000
Gas produced 1,000 cu. ft.	698,000,000
Available (0.56%) 1,000 cu. ft.	350,000,000
Equivalent (35M.=1 ton) tons coal	10,000,000
Tar produced, 1927 gals	523,000,000
Estimate burned gals	420,000,000
Equal bbls	10,000,000
3 1/3 bbls.=1 ton coal tons	3,000,000
Summary	
Saved by process tons	3,000,000
Equivalence of gas tons	10,000,000
Equivalence of tar tons	3,000,000
Total tons	16,000,000

duction of 12 percent in the demand for coking coal between 1919 and 1926. Assuming that these increased efficiencies began before 1919, it may be conservative to estimate 20 percent as the total saving over the more distant past. Using 73 million tons of coal for the production of coke (1927), this saving means a loss of market of 10 million tons. (Table VI.)

Increased efficiency in making gas and larger use of oil, and the swing from coal used in cookstoves to gas ranges, has resulted in an estimated loss of 19 million tons to the coal trade. (Table VII.)

We still have to consider the use of coal for power for general industry, in which there probably has not been the same increase in efficiency of use as in

TABLE V—DOMESTIC CONSUMPTION

	Tons
Used 1923	110,000,000
Estimated saving due to increased use of apartments, weather stripping, and heat insulation	10,000,000

TABLE VI—METALLURGICAL WORK

Between 1919 and 1926 the quantity of coal used per ton of pig iron made was reduced 12 percent (from 3.428 lbs. to 3,017 lbs). Subtracting 4.7 percent as due to efficiency in making coke (already taken account of) leaves 7.3 percent saving in metallurgical process.

	Tons
Coal used for coke in 1927 about	73,000,000
7.3 percent saving, over	5,000,000
Allow equal increases before 1919	5,000,000
Total saving	10,000,000

TABLE VII—GAS MAKING

In 1909 1 ton of coal was used for 30,500 cu. ft. of gas (with gas oil).

In 1925 1 ton of coal was used for 47,800 cu. ft. of gas.

Gas made in 1925—359,402,000 cu. ft.

At 1909 rate this would have required 4,000,000 tons more coal.

	M. cu. ft.
Gas made in 1909	150,836,000
Gas made in 1925	359,402,000
Difference	208,566,000

Assume that of this gain 150 billion cubic feet is due to swing from coal to gas for cooking, etc., and that the gas made by using 1 ton of coal will replace 5 tons of coal used direct (because of more efficient load factor); saving of, say, 100 tons of coal for each 1 million cubic feet of gas used, or 15 million tons all told.

1½ million tons of coke made in connection with 150 billion cubic feet of gas replace an equal amount of coal.

The burning of the corresponding amount of tar adds still further to the loss of coal demand.

Total loss, 19,000,000 tons of coal.

TABLE VIII

(a) Public utilities	50,000,000
(b) Railroads	75,000,000
(c) Domestic	10,000,000
(d) By-product coking	16,000,000
(e) Metallurgical	10,000,000
(f) Gas making	19,000,000
(g) General industrial	105,000,000
Total	285,000,000

TABLE IX—WATER POWER GROWTH IN HORSEPOWER

1869	1,150,000
1879	1,250,000
1889	1,300,000
1902	2,050,000
1909	3,870,000
1920	7,800,000
1927	12,296,000

From 1869 to 1902 water power less than doubled; at that rate there should be less than 4,000,000 H. P. today. The difference, say, 8,500,000 H. P., represents special gain. In 1926 water power used by public utilities produced 26,185,000,000 kwh. On the same basis as coal-produced kwh., this was equivalent to the use of about 25,000,000 tons of coal, on basis of present efficiency. Add 16 percent for manufacturing and miscellaneous water power gives as the total equivalence, 29,000,000 tons, of which 70 percent, or 20,000,000 tons, may be considered as extraordinary gain and a loss to normal coal market. However, reexpressed in the less efficient coal of last century probably equivalent to (120 percent) 43,000,000 tons.

TABLE X—PETROLEUM

	Barrels
Produced 1927	903,800,000
Imported	58,382,000
Total	962,182,000
Exported	15,843,000
Added to stocks	160,019,000
Into gasoline	330,783,000
Into kerosene	56,114,000
Into gas and fuel oil	393,176,000
Into lubricants	31,721,000

Estimates of equivalence of oil and coal vary from 1 ton of coal equals 3.2 bbls. of oil to 1 ton of coal equals 4.3 bbls. Taking an average of 3.9 gives about 100,000,000 tons of coal as replaced by the gas and fuel oil.

Assuming that gasoline from natural gas about balances the excess of gasoline exported over that imported, leaves 330,785,000 bbls. of gasoline.

There are several ways of estimating the coal replaced. Without definite figures it may be assumed that 30,000,000 bbls. were used in stationary engines and 300 million bbls. in transportation. On the basis 3.3 bbls. as equivalent to a ton of coal, this is equivalent to 100 million tons of coal. Taking account of difference in efficiency of gasoline burned in internal combustion engine, in contrast with fuel oil burned under boiler, the figure given may not be far off.

TABLE XI—SUMMARY: REPLACED COAL

	Tons
Loss to water power	45,000,000
Loss to natural gas	70,000,000
Loss to fuel oil	100,000,000
Loss to gasoline	100,000,000
Total	315,000,000

TABLE XII

	Tons
Gain due to increase in population, estimated for the 10 years at 10 percent	60,000,000
Gain due to increased use of energy (13 percent based on a gain of that amount between 1918 and 1927, applied to 600 million tons of coal, production in 1927). See Table XIII	78,000,000
Total possible gain (outside of new uses)	138,000,000
Loss due to gain in efficiency in power production (50 percent of 350 million tons)	175,000,000
Loss due to increased use of water power (estimating 80 percent increase in 10 years)	35,000,000
Loss due to increased use of natural gas, not over	50,000,000
Loss due to increased use of oil products	15,000,000
Total losses	275,000,000
Net loss in 10 years (a decline of nearly 14 million tons a year)	137,000,000
Estimated production of coal in the United States, 1937	463,000,000

TABLE XIII—ANNUAL SUPPLY OF ENERGY, FROM MINERAL FUELS AND WATER POWER. TOTAL AND PER CAPITA (U. S. DEPT. OF COM. YR. BOOK, 1928) (IN TRILLIONS OF B. T. U.)

Year	Coal	Oil and gas	Water power	Total	Per Capita million B. t. u. Coal	All
1913	15,025	2,219	588	17,831	156	185
1918	17,868	3,137	737	21,842	172	211
1925	15,306	6,231	1,290	22,827	133	198
1926	17,319	6,398	1,492	25,209	148	215
1927	15,813	7,184	1,687	24,689	133	208

24,689:21,842, :: 1.13:1

Showing an increase of 13 percent between 1918 and 1927.

public utility use; on the other hand, there has been a steady drift from production of power at mines and manufacturing plants to the purchase of power from the power utilities. This is shown, first, by the decline in horsepower installed at mines and factories between 1919 and 1925; and, second, by the increase in rented horsepower at such plants. The horsepower of factory motors using purchased power increased nearly eight times between 1909 and 1925. In 1923 the power purchased by factories, expressed in horsepower of motors, was 77 percent of the capacity of the generators of central stations and electric railways. I have estimated, and I think it is conservative, that there has been a loss to the coal trade through such shifting and through increased economy of use of not less than 105 million tons.* All of these give a total loss of market of 285 million tons. (Table VIII.)

(3) *Competition.* Competition has, I estimate, reduced the market for coal by not less than 315 million tons. First is water power. The use of water power increased very slowly during the last century. In the 30 years, 1870 to 1900, the total increase was less than 1 million horsepower installed, while in the first 27 years of this century the increase was over 10 million horsepower. For example: From 1879 to 1899 the increase was only 5 percent, while from 1920 to 1926 alone there was a 50 percent increase, or 10 times more than from 1879 to 1899, and the increase was 33 1/3 times faster. I estimate that water power replaces 45 million tons of coal yearly that would not have been replaced had the old rate of water power consumption continued. (Table IX.)

The second competitor is oil. Oil replaces coal in three ways: By burning in crude form, as fuel oil, and as gasoline. The last reduces the demand for steam and electric transportation. Using 3 1/3 to 3.9 barrels of oil as equivalent to 1 ton of coal, the writer has computed the loss to the coal market as 200 million tons. (Table X.) To this must be added the loss due to the use of natural gas, which I have estimated at 70 million tons,† or a total of 270 million tons for both. The United States Bureau of Mines estimate was 274 million tons. Summarizing these three losses of market, we have: Loss by increased efficiency, 285 million tons; loss due to competition, 315 million tons (Table XI); or a total of 600 million tons. Adding to that the actual production of 600 million tons gives a total of 1,200 million tons. Assuming that the old rate of population increase had been continued, there should be added 18 percent, or 216 million tons, giving a grand total of 1,416 million tons. This is not quite 1,500 million tons, but over 800 million of the 900 million tons have been accounted for.

What of the Future?

(1) Population is still increasing. Other things being equal, coal should share in the increased demand created by the increase in population. From 1910 to 1920 population increased by 14.9 percent. The rate of increase has been falling. It hardly seems probable, however, that it will fall below 10 percent for the coming 10 years. With the present production of 600 million tons that should bring an increase in production of 60 million tons. However, if other factors are as active in the next 10 years as in the last 7, that gain will be wiped out by the decreased per capita consumption. Per capita consumption has decreased more than 16 percent in the last 7 years, or at a rate of 23 percent for 10 years. In other words, if our robbers continue to rob in the future as fast as they have in the last 7 years we may look for a decline of 13 percent in the coal market during the next 10 years. What is the outlook for these other factors continuing their raid on coal?

(2) Increasing efficiency is a growing, lusty youngster. Today our power-making machinery using coal varies in efficiency from about 5 percent to 25 percent. That means that 75 percent to 95 percent of the energy of the coal is being lost in the process of converting it into mechanical or electrical energy, and leaves just about that much of a field in which economy can be made. The most efficient boilers and engines in public service use today are about twice as efficient as the average of those engines, and the efficiency of the best has been steadily increasing during the last 10 years. If in the 10 years just beginning this increase in efficiency continues and the average is brought up to the greatest efficiency of today, the coal bill of the public utilities will be cut in half. Increased use will add some tonnage. The average increase in use in kilowatt hours for public utilities during the past seven years was almost 100 percent. At that rate increased use of power made by those companies should offset the increased efficiency in use. Indeed, during the years 1915 to 1926, notwithstanding the increased efficiency of use, the coal demand of the public utilities has grown from 35 million to 41 million tons, and a similar increase may be looked for in the future.

Unfortunately the increase of power production by these companies (nearly 100 percent) is probably more than offset in its effect on power demand by transfer of power production from private firms to public utilities. During the same years that public utility horsepower increased from 17 million to 34 million (1919 to 1925) and the total from 42 million to 57 million, power for manufacturing, as expressed in horsepower installed, dropped from 20,038,000 to 19,904,000, for mining from 5,102,000 to 5,100,000, etc. Applying to this stationary horsepower equipment some of the gain in efficiency of public utility corporations, it seems possible that the slight gain in coal used by the utilities (6,700,000 tons) is more than counter-balanced by the loss in the general industry.

Forty years ago it was thought that the quadruple-expansion-marine engine utilizing less than 15 percent of the energy of the coal had about reached the limit of efficiency. Today 20 percent efficiency is not uncommon, and we are rapidly pushing toward 25 percent. Even when we reach 25 percent we have a loss of 75 percent, a field still inviting us to recover part or as much as we can of this now lost energy. Indeed, we seem at the door of a new era in which, by the use of complete gassification of the coal and its use in internal combustion engines, or the use of engines suggested by the new mercury-vapor engines, and the use of until recently unheard of pressures, we can but feel that the next 10 years may see a gain in efficiency in power production that will cut the present use of coal for steam raising in two. That, however, is only a possibility. It takes time to replace equipment, and cost reduction is more or less offset by increased use.

On the whole, therefore, I look for continued gain in efficiency probably quite as great during the next 10 years as during the past 10 years, offset in part by an increased use of power. The effect of this will probably be increased coal sales to public utilities but far overbalanced by decreased sales to general industrial plants, which will more and more turn to public utility companies for their power. The future use of coal by railroads will decrease because of extensive electrification, much of which is already planned; the replacement of inefficient locomotives with more efficient ones; and growing bus and truck competition. It is estimated that electrification means replacing a locomotive that uses 7.5 pounds of coal, with stand-by losses, for every kwh. with central-station power generated with 1 pound of coal per kwh.

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* General industrial, iron and steel, coal used in 1927 about 175,000,000 tons. If saving due to increasing efficiency in use of coal be estimated at about one-half that recorded by the public utilities or about 60 percent, there has been a loss to the coal trade of 105,000,000 tons.

† Gas, natural.
Production 1927, estimated 1,500,000,000 M. cu. ft. Practical tests 30 years ago showed that 1 ton of coal equals in use 20,000 cu. ft. of natural gas. Assuming parallel gains in use efficiencies gives:
Loss to natural gas (1927), 75,650,000 tons. Of this probably 70,000,000 tons may be changed to growth in this century.

or 1.5 pounds to allow for transmission and all other losses, a saving of 400 percent.

(3) *Competition.* Now comes the real problem. The use of water power has increased rapidly during this century. It more than doubled from 1900 to 1910. It nearly doubled again from 1910 to 1920. In the seven years from 1920 to 1927 it has increased 57 percent. At that rate it will increase 82 percent from 1920 to 1930. January 1, 1928, the total water power development was expressed as 12,296,000 installed horsepower. It is estimated that the total potential water power of the United States is about 80 million or 85 million horsepower, or 6½ times the present development. Of this it is estimated that over 35 million horsepower is available 90 percent of the time, and over 55 million 50 percent of the time. At present there are two very large undeveloped water powers in the East that may come into being during the next 10 years. These are an increased use of Niagara, prevented at present by an international treaty; and, second, the use of the St. Lawrence. The bulk of the undeveloped power lies west of the Rocky Mountains. On January 1, 1927, licenses had been issued for the building of 3,200,000 horsepower-capacity water-power plants on public lands, so that a total increase of 80 percent does not seem unreasonable.

On the whole it seems that the next 10 years will see a continued development of new water powers that are likely to affect the use of coal to the extent of that development, except as the increase is absorbed by increased use.

Now we come to competition with oil and gas. A few years ago it was thought that gas in the Eastern States and oil in the United States generally had reached the climax of their production, and were about ready to decline. Today the producers of both oil and gas are looking for new customers to absorb their surplus. This increased production is due to numerous reasons: (1) better care of producing wells. Thousands of old wells have been cleaned out and changed from poor producers to good producers. This is probably the explanation for the Appalachian gas fields keeping up as good a production as they have. (2) Deeper drilling. (3) Flooding by water, and repressuring by air, gas, and air-gas mixture. This drive is forcing out oil that would otherwise have remained in the rock, so that while the present production is greatly increased the ultimate life of these fields is much shortened except where such a drive is used in fields already exhausted by pumping. (4) The use of new geophysical methods for the location of favorable drilling localities in areas where surface conditions give no clue to the underground structure.

In general the gas fields of the older gas-producing states show a slow but steady decline. Pennsylvania, due to the increasing care of old wells, has maintained an almost constant production of between 101 billion and 112 billion cubic feet of gas for several years, though the reduction from its height of 138 billion cubic feet in 1906 is considered to be a definite sign of approaching exhaustion. West Virginia has declined from 308 billion cubic feet in 1917 to 180 billion cubic feet during the past few years. Ohio has declined from 79 billion cubic feet in 1915 to 47 billion cubic feet in 1926.

Production is steadily mounting in the West and Southwest. Production in Arkansas increased 40 times in the last 10 years; in Louisiana 6 times; in Oklahoma 3 times; in Texas 10 times; and in Wyoming 90 times. As a result, these states are seeking new outlets for their gas. A 22-inch pipe line has just been completed to Denver, and others are contemplated or under construction to Chicago, St. Louis and other cities, including way stations. These new pipe lines will furnish much needed outlets for the surplus gas from the Southwestern fields; but no one can doubt they will have a profound affect on the markets for coal from the Central and Western fields. It would not be surprising if gas from the Southwestern fields should not eat into the bituminous coal market to the extent of 50 million tons a year, but hardly more than that.

Oil, which a few years ago had one foot in the grave, appears to have been inoculated with the elixir of youth and threatens to become a drug on the market. The production in October just passed was the highest monthly total ever recorded. At the same time the use of foreign crude reached a new high level. All of this, notwithstanding that stocks are increasing and it is generally recognized that the market is oversupplied, and every effort being made to put on the brakes. It is stated that about one-third of the possible production of California is shut in, and so of some of the other Western states. It is said that 75 salt domes have recently been located by new geophysical methods and that of these 32 have been tested and 28 found productive. It is true that production from Mexico is rapidly falling off, and at the present rate of decline will soon be gone; but Venezuela has come in as fast as Mexico has declined, and promises to become a greater producer. At present the United States is importing about 140,000 barrels of crude a day from Venezuela. Some of this oil, I understand, is being piped across Pennsylvania to a refinery in the western part of the state.

It therefore appears highly probable that there will be plenty of oil to meet the growing needs of this country for several years. No one can say just how many. At present the prospect is that there will be little material change in prices due to shortage of supply in the next five years, though efforts of the oil industry to control production may result in some slight increase over present extremely low prices. It hardly seems possible that the present flood can be maintained more than ten years. I do not look for a very much larger encroachment of oil on coal, though oil will undoubtedly continue to supplant some coal for a few years in the immediate future. I have estimated a replacement 10 years from now of 15 million tons above present replacement. The replacement in the interim may exceed that amount, but if so I estimate it will decline to 15 million tons at the end of the 10 years.

To this point we have as shown in Table XII, assuming general business conditions to continue as at present.

No special weight should be given to these particular figures. They are, however, indicative that the market for coal is not likely to grow and may during the next 10 years register a considerable decline.

It should be understood that some new invention or the successful application of known principles to new methods of energy production may, at any time, cut the amount of coal used for energy production in half, quite aside from a general gain in efficiency due to exchanging inefficient equipment for more efficient equipment and minor gains in mechanical engineering.

The decline indicated should be gradual over the 10 years, taken as a basis of computation. After that I look for the curve to level off followed by an upward turn as the rate of new waterpower installation decreases, as I believe it will, in the eastern area at least, and as the supplies of oil and gas fail to keep pace with mounting demand, with the result that oil will be more and more diverted to automotive use and to lubrication solely. The year 1950 should see bituminous coal production definitely climbing again unless prevented by unexpected increases in efficiency of use.

New Uses of Coal

Finally comes the question: *Are there not new uses of coal in sight that will offset this anticipated decline?* Among uses little developed as yet in this country are the following: (1) Hydrogenation of coal for the production of oil; (2) the complete gasification of coal, the gas to be used in internal combustion engines; (3)

the low temperature distillation of coal primarily for the production of smokeless fuel; (4) the use of coal in the production of fertilizer; (5) the increased use of electricity for heating; (6) collodial coal.

The use of coal for the production of oil is seeing practical application in Germany, and doubtless will spread in that and other European countries where oil production is almost nil and oil demand very large. With the very large supplies of oil and oil shale in this country, however, it may well be doubted if the hydrogenation of coal will be a commercial factor for at least one or two centuries.

The conversion of coal into gas for use in internal combustion engines would probably tend to reduce the demand for coal rather than to increase it. It has long been known that such a process secures a much higher efficiency in steam production, so that, unless counterbalanced by increased use of power, the tendency of this new use will be to decrease the demand on coal.

The low temperature distillation of bituminous coal for the production of smokeless fuel would appear to be a use that would demand a larger supply of coal, as the volume or weight of smokeless fuel produced is much less than that of the coal used in the process. To supply therefore a given demand for heating or other usage will require a larger amount of coal in the beginning. A large amount of experimental work is being carried on along these lines, but up to the present has given little promise of a large immediate development such as would affect the coal market in the immediate future. Ten years from now this use of coal may have been definitely established and it may be coming into its own; but it is hardly likely that the coming 10 years will see it so thoroughly established and so largely used as to materially help in maintaining large coal production.

The production of fertilizer by the use of coal may have large influence on the coal markets of Europe where lands have been under cultivation for many centuries and so far exhausted that constant supplies of fertilizer are necessary. In this country, with its newer lands, the use of fertilizer is not as general nor always as necessary as in Europe, and while the future may see large tonnages of coal used in the production of fertilizer the outlook for the next 10 years does not indicate much help for the coal man from this use.

The use of electricity for heating is slowly but steadily growing. Today electric cooking stoves are not uncommon and electric house heating is slowly coming in. As it takes from 4 to 10 times as much coal to heat through electricity as to heat with coal directly, a large demand for electrical heating would have a large effect on the coal market. Indirect electric heating using a hot-water boiler, to be heated in the small hours of the morning, usually from hydroelectric current, may become a reality without greatly affecting the coal market. Colloidal coal, that is coal ground very fine and mixed with a small quantity of oil and a fixative to prevent settling, so that it will flow like oil, may come into use in the next 10 years. But from the present outlook for oil there is little incentive for such development in the immediate future.

On the whole, therefore, new uses may be said to balance each other in their probable effect on the coal trade for the next 10 years with the possibility that through the conversion of coal into gas and its use in internal combustion engines the new uses will tend rather to reduce the demand for coal than to increase it. This may be cold comfort, but we are trying to face the facts. Undoubtedly the only way that prosperity can come to the coal industry is by finding a way of readjustment by which the industry reduces its productive capacity to a point where those in the industry can continue at a profit. This may need some major surgical operations. It may need some help from the Government in restraining the opening of new mines the moment that the industry reestablishes itself on a going basis.

Competition and changes within the industry itself as affected by the future outlook for coal are outside the scope of this evening's discussion, which has troubles enough of its own.

INDUSTRY'S RELATION TO HUMANITY
(*From page* 100)

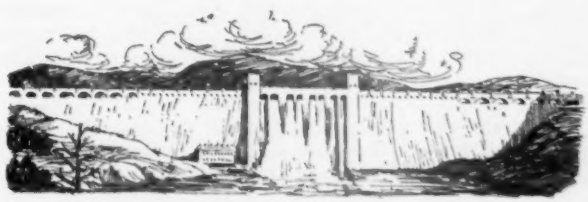
his head to do business, and that he could do business in any part of the world as long as the money flowed into the stockholders of the company.

Now it is a fine thing to use one's head, provided one uses the whole of one's faculties. But it is quite possible for a man to be penny wise and pound foolish, and history teaches us that men have always had a tendency to be just that. The manufacturer whom I met on the steamer had adopted a policy that is bound inevitably to destroy the purchasing power of the people of America. He is wringing the neck of the goose that lays, or has power to lay, the golden eggs. There are a great many others who are engaged in the same sort of task. Some of our employers are duplicating their plants, with one plant in one section of the country and the second plant in another. One plant they operate for six months, and the second another six months, to supply the market. Some have gone so far as to establish plants abroad, and are pitting these against the home plants, on the theory that it gives them better control of the labor market. They forget that lowering the labor market lowers the labor market for their own products.

I often wonder if these people know what the upshot of their policy is destined to be. In past times such methods have aroused bitter dissension.

Now, I am sure that we have no problem in this country which can not be settled, if we possess the good will for settling problems, and as one of the greatest of German philosophers, old Kent of Koenigsberg, said, "There is nothing that is good in this world, except the good will." The only question is whether we in America possess a good will or not. I believe that the overwhelming majority of us do possess it. But there is a not inconsiderable minority, possessing a considerable measure of wealth and power, of which it can hardly be said that the good will is a salient feature of their minds.

As I have said, I believe that the great majority of Americans are men of good will. I believe that this is true of the greater number of employers, and of the greater number of workers. Because I believe this, I believe likewise that all the industrial problems confronting us will, sooner or later, be settled. But I want to emphasize my conviction that the only hope for us lies in this asset of good will. If certain types of men whom I know—some of them employers, some of them employes—were predominant in America, my faith in the solution of these problems would be, I'll admit, almost at the point of zero. We can no longer believe that there is a mystical kind of force in the world of the sort that Herbert Spencer called the "law of evolution" which in its own good time doeth all things well, whether we seek to cooperate with or hinder it. Men have always had to proclaim to the world the principles of justice and truth; and they have ever had to labor to see that the principles of justice and truth prevail. As it has been in the past, so it will be in the future. My faith in the destiny of America is my faith in the good will of the majority of Americans. In the spirit of good will let us approach all the problems of industry, including the great problem of industry's relation to humanity.



SERVING INDUSTRY THROUGH AMERICAN STANDARDS*

By WILLIAM J. SERRILL†

Work In Development Of Industrial Standards Advancing Rapidly With Industry Cooperating Wholeheartedly—The Re-Organizing Of American Engineering Standards Committee Into The American Standards Association Offers Splendid Facilities For Creating National Standards

THE prospects of national standardization were never so bright as at this moment. After an existence of approximately 10 years, the movement, in the national sense, is now finding itself. Considering the vast scale of industry in this country, this period of initial adjustment is not unreasonably long.

William J. Serrill

The national exponent of standardization, the American Engineering Standards Committee, was founded by the five major engineering societies at the time when our Nation was engaged in the World War. The object of the organization was to serve as a clearing house among the standardizing activities of the different industries. Without such an agency there would be much overlapping and confusion, and it was hoped and believed that this new body would promote efficiency and effect economy among the standardizing activities of the Nation. During its brief life the organization has substantially fulfilled the hopes of its founders; it has an impressive list of adopted standards to its credit, and has achieved a reputation which is worth while.

Experience in prosecuting the work during these years has demonstrated that this body could work more effectively if some changes were made in the details of its organization. After thorough study, involving a vast amount of work in harmonizing conflicting opinions, a new constitution has recently been adopted. The nature of these changes in the organization I will now attempt briefly to explain:

The American Engineering Standards Committee was composed of member bodies, each member body being a national engineering society or a national trade association. The delegates from the member bodies composed the Main Committee, which administered the affairs of the organization. The principle on which the organization was founded was that the organization itself does not make standards, but it judges whether the standards which are made by different industries, when presented for approval, represent a real consensus of these industries. The attitude of the American Engineering Standards Committee was thus a judicial one, and the representatives from the member bodies were selected for the purpose of performing this judicial function. They were mostly engineers or men technically trained and admirably suited to perform the deliberative and judicial functions for which they were appointed, but not so well adapted to carry out the executive duties of the organization.

The new constitution, therefore, provides for a board of directors of not more than 12 members, who shall determine the policies and attend to the administrative work of the organization. The formation of this board of directors is a recognition of the fact that the standardization movement is one that interests the executives in industry, and is not exclusively allied with the engineering departments. Under the new constitution the former Main Committee is continued, with the title "The Standards Council," having under its direction all the technical problems connected with the approval of standards.

This process of reorganization has involved a complete study of the questions of procedure, resulting in the adoption of additional methods by which proposed standards may be submitted and approved, thus indicating a more hospitable attitude toward the different standardizing methods of different industries.

Not the least interesting of the changes which the reorganization has effected is the change of the name from "American Engineering Standards Committee" to "American Standards Association." It had become apparent that the word "committee" in the former name was somewhat misleading; it contained a note of inferiority, as indicating that the body was a secondary one. The body, as it has developed, is really the exponent of national standardization, not only coordinating the standardizing activities of the industries but stimulating the movement, and encouraging backward industries to take part in it. In a similar way some exception was taken to the word "engineering" in the title, as experience has more and more shown that the standardizing movement is a broad movement in industry; that it is largely the function of trade associations and not exclusively that of engineering societies. All the same, our activities lie mostly in the engineering, or technical, field. After mature consideration, the words "engineering" and "committee" were dropped from the title, and the simple, brief name "American Standards Association" has been adopted.

The fundamental basis on which the American Standards Association rests is the fact that when it declares a standard to be an American standard, this standard always represents a true consensus of the industry concerned. The procedure which must be followed in the preparation of standards, and the judicial inquiry which is made by the association when standards are submitted for its approval, assure the presence of a real consensus. Under the procedure, the technical committee engaged in preparing a standard must have in its ranks representatives from all sections of industry which have a legitimate interest in the project. By thus requiring this catholic representation on the committees by which standards are made, the association guarantees to the world of industry that

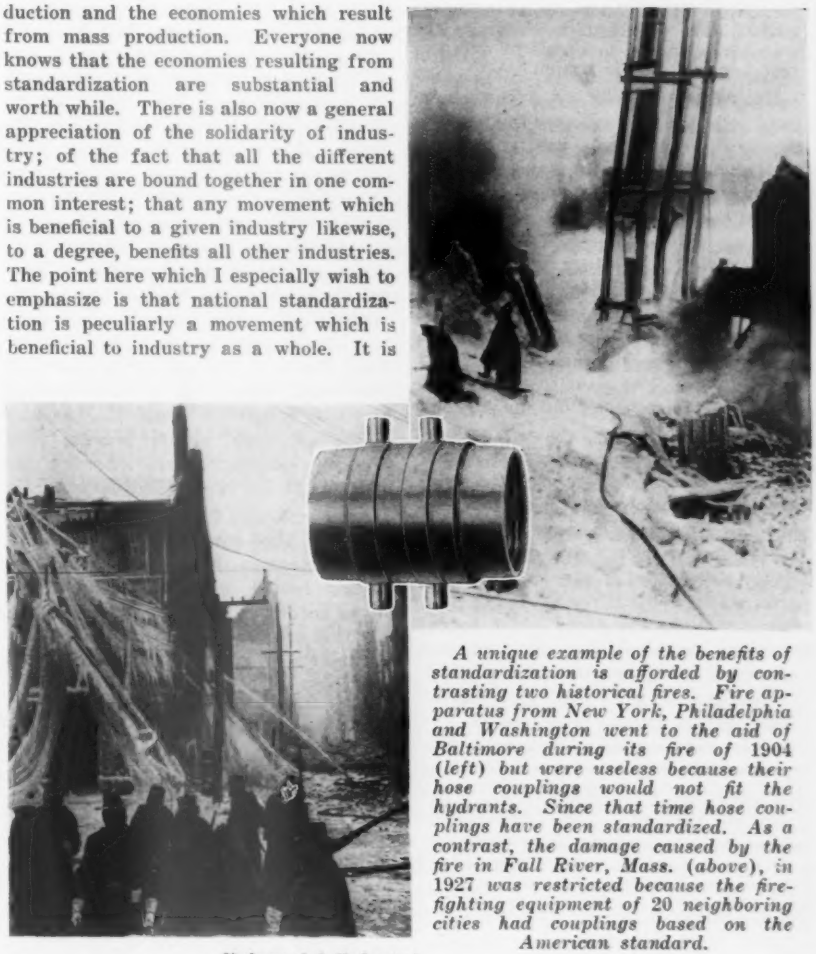
* Presented to 31st Annual Convention, The American Mining Congress.
† Chairman, American Standards Association.

its approved standards are based on a real agreement among all legitimate interests. This is the fundamental basis on which the association rests, and, so supported, its position is impregnable.

Adequate financial support by industry is, of course, essential to the success of the standardization movement. Sustaining memberships on the part of companies, big and little, with dues proportioned to the relative sizes of the companies, is the only fair basis of support. The standard basis for sustaining membership dues is 1 cent per $1,000 of gross income, or 1½ cents per $1,000 of capital invested. On such a basis the burden of support on the part of any company is not heavy. A careful study of the conditions reveals that an income of not less than $150,000 per annum is needed in order adequately to prosecute the work. This is a moderate figure, compared with the incomes of many of the national technical societies, and is an insignificant fraction of the vast savings effected by standardization.

Experience has shown, however, that there is a tendency on the part of corporations to evade this responsibility. They will argue, "We support our trade organization; it is a member body of the American Standards Association, paying $500 per representative. Therefore, we need not pay sustaining membership dues." Or they will argue further, "We are working on this or that technical committee, which is preparing a standard in our industry, and we are helping to support certain experimental or research work which is required in the preparation of said standard. Consequently, we are spending on standardization as much as we can afford to spend, and, therefore, we will not accept their invitation to become a sustaining member." With full appreciation of the sums which are thus being expended by various companies in the preparation of standards of their respective industries, it is pointed out that the funds thus distributed do not contribute one penny toward the necessary expenses of the central office—the salaries of engineers, clerks and accountants, and the payment of rent and office expenses. The fees paid by member bodies can not advisably be increased, and the sum of them is quite inadequate. National standardization is an important factor in effecting economies in industry. Industry can not afford to let it fail by refusing the very moderate financial support which is necessary to the maintenance of the national clearing house.

So much has been written and spoken about the standardization movement within the past few years that I will not encroach on your time by descriptions of what standardization is, nor of the philosophy which underlies it. Everyone knows that its object is mass production and the economies which result from mass production. Everyone now knows that the economies resulting from standardization are substantial and worth while. There is also now a general appreciation of the solidarity of industry; of the fact that all the different industries are bound together in one common interest; that any movement which is beneficial to a given industry likewise, to a degree, benefits all other industries. The point here which I especially wish to emphasize is that national standardization is peculiarly a movement which is beneficial to industry as a whole. It is a universal economic solvent. No industry, or no company engaged in industry, can escape its benefits. It reduces the cost of what you make and sell, but, not less, it reduces the prices of everything you buy. No company is justified in refusing moral and financial backing because the articles manufactured in its own industry are not at the moment being standardized.



A unique example of the benefits of standardization is afforded by contrasting two historical fires. Fire apparatus from New York, Philadelphia and Washington went to the aid of Baltimore during its fire of 1904 *(left) but were useless because their hose couplings would not fit the hydrants. Since that time hose couplings have been standardized. As a contrast, the damage caused by the fire in Fall River, Mass. (above),* in 1927 *was restricted because the fire-fighting equipment of* 20 *neighboring cities had couplings based on the American standard.*

Underwood & Underwood

I would not hold up national standardization as being anything in the nature of a universal panacea. Good management, wise financing, national advertising, research—these are all factors in the marvelous growth and prosperity of all of the industries, and national standardization is only one of these. It is, comparatively speaking, a newcomer in the field, but it can certainly demonstrate its ability to effect enormous economies, and I bespeak for it the support of the mining industry.

Probably the first reaction of the man in the street when the subject of standardization is brought to his attention is that it checks initiative and hampers the introduction of improvements, due to invention and ingenuity, in the industries where it is applied. While at first glance there is a certain plausibility in this criticism, further thought will convince anyone that it is ill-founded, and that the tendency is the reverse of the one claimed.

Standardization, if kept within its proper limits, really stimulates, instead of blocking, improvements in the articles manufactured. It reduces the great mass of distracting detail into ordered form, so that the mind is free to exert its inventive genius toward improvements. The head designing engineer of a large manufacturing company testifies as follows:

"The standardizing of our product has opened the door to important improvements in it. In the old days my time and thought were occupied in adapting our appliance to the demands of different customers. Then, too, as a result of so many types, it was hard to know where to start in the attempt to improve. Now that we furnish only a standardized product, I have a definite basis on which to start, and, being free from designing the numerous modifications demanded by different customers, I have the time to devote to devising improvements in our

standard type. And we have never found any difficulty in having the standard changed in order to admit a real improvement in design."

Mr. Albert W. Whitney, a past chairman of the American Engineering Standards Committee, has ably dealt with the philosophy of standardization. In his pamphlet, "The Place of Standardization in Modern Life," which it will well pay anyone interested in this subject to read, Mr. Whitney points out how industry, in utilizing standardizing methods, is only following the method of nature, which standardizes in separate species its different forms of plants and animals, instead of permitting innumerable individuals, each differing from all the others, to complicate the natural world. The principle of variation, acting under the influence of natural selection, slowly produces changes when surrounding conditions demand it, but as fast as improvements are evolved they become stereotyped in species which are permanently, but not irrevocably, fixed in character. The standards which industry make are similar in their nature; permanently, but not irrevocably, fixed, and always open to the improvement which inventive genius may present.

I may best succeed in giving you a concrete picture of what standardization sets out to do by citing a few of our important projects. With these objects before you, you may, by the exercise of a little imagination, conceive how standardization may be applied to accomplish important results in your own industry:

Fire Hose

The standardization of specifications for fire hose was suggested by the leading fire-protection interests and the American Society for Testing Materials, in order that under the procedure of a committee made up of representatives of all groups having an important interest in the subject, specifications covering rubber-lined fire hose for public and private fire departments might be set up in such a way as to harmonize serious differences then existing between the several specifications in common use, the first of which dates from 1897.

Under the present technical committee, representing 10 trade, technical, and governmental bodies directly concerned, having for its chairman the representative of the Federal Specifications Board, one of the bodies which has brought out a specification in conflict with requirements already in existence, unanimous agreement on a single national specification has now been reached, which will shortly be ready for promulgation.

Fire Hose Couplings

A related subject likewise of greatest significance to municipalities as well as private industries is that of fire-hose couplings, with regard to which an American standard has been set up under the auspices of the American Engineering Standards Committee with the American Society of Mechanical Engineers, the American Water Works Association, and the National Board of Fire Underwriters acting as leaders in the work. This standard has for its purpose to eliminate the great diversity of fire-hose couplings which before the establishment of the standard had greatly hampered cooperation between different cities. Thus, for instance, in 1904 there was a great fire in Baltimore, and the fire-fighting equipment rushed to the aid of that city by New York, Philadelphia, and Washington was forced to stand idle without giving any help, simply because their fire-hose couplings would not fit the hydrants of the city of Baltimore.

As a contrast, the fire in Fall River, Mass., of 1927 may be cited. The ultimate damage in this case—although important enough in itself (parts of six blocks burned up)—was restricted by the fact that about 20 neighboring cities lent aid, the hose couplings of these cities and Fall River all being based on the American standard; therefore no difficulty was encountered in connecting the hose of the different brigades. It is almost certain that if this aid had not been so effective the entire city would have been destroyed.

Approximately one-half of the 8,000 cities and towns in the United States having fire protection in the form of hydrants and fire hose already use standard fire-hose couplings, and three-fourths of the remainder have threads that can be readily altered so as to conform to the American standard. Twenty-five of the protected cities included in the 4,000 which have adopted the standard have populations of 100,000 and over.

Gaging Methods

Mass production of composite articles is in general impossible without interchangeability between the component parts; again, interchangeability of parts is impossible without standardization of certain limits between which their significant dimensions may vary, the distance between the two limits of a dimension being called "tolerance."

In actual production, the manufacturing limits are maintained by means of "limit gages," each dimension being governed by two gages representing the high and low limits.

To what extent the use of limit gages cuts down the production cost may be seen from an example based on the actual experience of a large plant. This factory's cost of manufacturing a well-known rifle amounted to $100 without the use of gages and to only $24 when limit gages were used.

With a view to the extensive use of limit gages in large industries like the automobile industry, the small-arms industry, the electrical industry, etc., it will be obvious how important the establishment of a national standard for fits and methods of gaging is. Such national standard facilitates the assembly of different products often made in factories located at great distances from each other. It also establishes a uniform basis for the gages themselves which then can be manufactured for stock as regular measuring tools. This will considerably cut down the cost of gaging and thereby tend to further the introduction of their use.

An American standard on "tolerances, allowances and gages for metal fits" was approved by the A. E. S. C. in December, 1925, and has been adopted by a number of organizations to replace their own gaging system, and by other organizations who so far did not have any gaging system at all.

Pipe Flanges and Flanged Fittings

The tentative American standard on "steel pipe flanges and flanged fittings" approved by the A. E. S. C. in June, 1927, is the result of five years work by a sectional committee consisting of 59 members representing 28 national organizations. The work was sponsored by the American Society of Mechanical Engineers, the Heating and Piping Contractors' National Association, and the Manufacturers Standardization Society of the valve and fittings industry.

Organizations manufacturing pipe fittings and valves, steam turbines, steam pumps, steam boilers, refrigerating machines and plants, and piping systems, took part in the work together with central power stations, industrial power plants, oil refineries, gas manufacturing plants, railroads, steam heating plants, ice manufacturing plants, water works, the plumbing field, shipbuilders, and the U. S. Army and Navy. Moreover, consulting engineers, architects, and college professors with national reputations collaborated as independent experts.

The success of this work may be measured by the fact that the large manufacturers of flanges and fittings had formally adopted the standard as soon as it was issued, and moreover by the fact that in the first six months after its approval nearly 17,000 copies of the standard were sold by the A. S. M. E. office, in addition to those sold by A. E. S. C. headquarters.

The importance of this standard will be obvious when it is considered how pipe lines requiring flange connections are used in practically all industries, while the great diversity of apparatus to be connected by pipe lines in the different

industries necessitates standardization on a national scale in order to secure interchangeability.

Cast Iron Pipe

Including dimensions, metallurgy, prevention of corrosion. The original object of this standardization was to simplify the problem for the pipe foundry, occasioned by the existence of concurrent specifications applicable to the same service, including American Gas Association, American Society for Testing Materials, American Water Works Association, New England Water Works Association. Differences between these specifications were in many cases nonessential but occasioned costly production and storage of patterns by foundries. After the work was begun it was discovered that rational and economical design of cast-iron pipe required laying a solid basis of scientific data, particularly as regards methods of test and protection against corrosion, both factors of the greatest economic importance. On the committee handling this work, 20 trade associations, technical societies and Government bodies are represented through 35 individuals, including such vital interests as the four associations mentioned above and the National Fire Protection Association, the U. S. Bureau of Standards, and eight cast-iron pipe manufacturers.

Tubular Steel Poles

Steel poles, used largely by the electrical utilities, at one time represented a variety of production amounting to 2,000 different sizes (1,400 in the catalog of a single company). These have been unified to 16, through a sectional committee representing such interested groups as the American Electric Railway Association, National Electric Light Association, and the American Welding Society, and containing a total of 12 representatives of 6 associations. The specifications developed have the effect of greatly simplifying the process of manufacture for all producers of this product and assuring that unified methods of test and inspection will be applied, with the effect of simplifying for the user the process of selection and of eliminating in a large measure causes of controversy in connection with deliveries.

Dry Cells

This standardization of dry cells and dry batteries applying to telephone, gas engine ignition, flashlight, radio, signal lights and bells, and other common uses, provides for minimizing the number of types and sizes and the establishment of standard methods of test, and sets up recognized requirements for performance so that this commodity, which a few years ago was very variable in its quality, is now characterized by a high degree of reliability. The uniform test methods that have been set up in these specifications provide assurance that tests conducted in widely different places and with different types of equipment may be accurately compared and the relative value of the product of various makers reliably determined.

The specifications for dry cells adopted by the A. S. A. are also those of the Federal Government, under whose auspices the technical work was done. These specifications, now generally accepted throughout the industry, represent a healthy growth from specifications originally developed by the Federal Government, and now made acceptable to representatives of all interests concerned, of whom all members voting, 21 in number, representing trade and technical organizations, were unanimous for the adoption of these specifications.

Screw Thread; Pipe Thread; Wrench Head Bolts and Nuts

These projects are mentioned together because they are closely related and concern items used throughout the whole range of mechanical equipment and tools, including pipe lines. Wrench head bolts and nuts provided with American (national) screw thread are applicable in almost every branch of the mining industry. Their general adoption will make them easily available at lower prices from firms specializing in the manufacture of such products.

In order to make my picture of the activities of the American Standards Association fairly complete, I must not omit to mention the approval of safety codes. While it is probable that the founders of the association did not have the safety code field in mind when they set the association on its feet, it soon developed that the methods of the association in guiding the development and approval of standards were admirably suited to the development and approval of safety codes, and this soon became an important feature in our work.

Only a few years ago, when our industries were beginning to expand, with the promise of reaching their present rapid stride, it became evident that safety regulations of some kind would be needed. The first tendency was to evolve such regulations in the shape of laws adopted by the state legislatures. An important objection to such a method of securing safety in any industry is the fact that laws are of a permanent, fixed character, and, in the face of a rapidly expanding industry, their requirements soon become obsolete. As opposed to this legislative method of enforcing safety requirements is placed the safety code. Such a code, adopted by a real consensus of the industry and endowed with the standing which the impress of the American Standards Association imparts, can be adopted as a regulation by such department of the state or municipal government as is concerned in such matters. The safety regulations of the code can thus be enforced by the Government, while, at the same time, the code is subject to change and improvement as the industry grows and conditions change.

Under American Standards Association procedure the technical committee which has produced a code is continued in existence for the purpose of modifying or improving the code as conditions warrant, and the state or municipal regulating body simply substitutes the improved code for the old one. This safety code experience constitutes an interesting exhibit of how our national clearing house in standardization has actually captured an important field of work from the activities of lawmaking bodies. In effect, industry is voluntarily effecting its own legislation, and doing it more effectively and profitably than it can be done by the national or state legislatures. I must not neglect to add that, in practice, there is a general voluntary adherence to the requirements of safety codes, quite independently of governmental regulations.

It seems fitting that I should in this address make some reference to the activities of the National Government in the standardization movement, and of its relation to the work of the American Standards Association.

From the very beginning, several departments of the Government have been member bodies of the American Engineering Standards Committee. These are: The Departments of Agriculture, Commerce, Interior, Labor, and the Navy and War Departments. The cooperation of these departments has always been cordial, and their contribution toward the work of the organization has been very helpful. Representatives, especially from the Navy and War Departments, took an active part in the committee which planned our reorganization. The Department of Commerce, through the Bureau of Standards, has been exceedingly active. The bureau is now acting as sponsor for a greater number of our projects, I believe, than any other single sponsor. Representatives of the Bureau of Standards are likewise serving as members of numerous technical committees which are preparing standards under our procedure. The laboratories of the bureau are busy on problems arising out of standardizing work.

In January of this year, the Bureau of Standards announced the formation of a new department, entitled "Commercial Standards Unit," designed to promote and approve so-called "commercial standards" when so requested by any branch of industry. The announced purposes and functions of this new department

were so similar to the purposes and functions of the American Standards Association that many leaders of industry throughout the country, interested in standardization, have been disturbed by what, on the surface, seems like a competition between this department of the National Government and our association. While I admit that there is this appearance of competition, I am glad that, as the result of subsequent negotiation, I can assure those who entertain this fear that no competition in fact exists. The Bureau of Standards agrees to submit each of its commercial standards, when issued, to the American Standards Association for passage through our procedure to the rank of American standard; the bureau volunteering to act as sponsor in each case.

I suppose nearly everyone engaged in directing the activities and policies of industry in this country desires a minimum of governmental participation in business. We all agree that it is better for the industries of the country to undertake their own policing and to determine their own policies. Standardization, especially, seems to be a movement for the benefit of industry which should be undertaken by industry under its own guidance and at its own expense.

Since the American Engineering Standards Committee was organized, the industries of this country have not shown a disposition to give the national standardization movement the proper financial support. Now that our association has been reorganized, there is every hope that the proper support will be forthcoming, and, if so, it is my belief that the American Standards Association will be able to render a satisfactory service to the industries in connection with their standardizing work, and that, consequently, the Commercial Standards Unit of the Bureau of Standards will be burdened with a decreasing number of such requests from the industries. On the other hand, if our association should not receive adequate support from industry, it seems probable that the coordinating of standardizing work by the industries will more and more be done by this department of the Bureau of Standards.

I hope that nothing which I have here said can be taken to indicate any lack of appreciation of the help which the Bureau of Standards has been in our standardizing work from the beginning, or of the importance of the bureau's continued help in the future. The prestige of the bureau as a branch of the National Government, when placed back of our issued American standards, is undoubtedly of value. And I am glad to point out that it is the announced intention of the Commercial Standards Unit to use its influence and its facilities to further the introduction into practice, through the industries, of our American standards.

In closing, I venture to bring to your attention the effect of standardization on labor. Standardization is a tool of the machine age. It fosters mass production; it tends to substitute machinery in place of hand labor. In so doing, we know that it acts favorably in the interest of labor. The continuance of high wages depends on a large output on the part of the individual workman. In so far as standardization tends to increase the output of workmen, it tends to maintain, or even to increase, a high rate of wage. In view of these facts, labor has a real interest in the promotion of standardization.

On the other hand, labor can not avoid viewing with real concern the dislocation, possibly accompanied by anxiety and suffering, which are brought on many individual workmen and their families by the substitution of machinery for hand labor. It is surely to the interest of the great mining industry—employers and laborers alike—to give careful study to this problem; a problem which is precipitated by, and is incidental to, the economic advancement of the industry. Whatever steps can be taken to render such changes easy should be taken; whatever it may be feasible to do in mitigation of the anxiety and suffering occasioned by changes in the conditions of employment should be done. I feel that I can not better close this address than by recommending this problem to the earnest attention of the mining industry.

BENTONITE—A MINERAL OF MANY POSSIBILITIES

One of the oddest and least known mineral substances is bentonite, according to the United States Bureau of Mines. Certain bentonites have such strong affinity for water that they are capable of absorbing more than 10 times their volumes of water. Owing to its peculiar physical properties bentonite has been suggested as a component material in the manufacture of a great variety of commodities as diversified as paper, rubber, putty, phonograph records, pencil leads and soaps. On the other hand, underground deposits of bentonite have caused great difficulties in the drilling of oil wells, it frequently becoming necessary to take special steps to combat the nuisance.

The properties, mining, preparation and utilization of bentonite have formed the subject of an investigation recently conducted under a cooperative agreement between the United States Bureau of Mines and the Mackay School of Mines, University of Nevada. A large number of samples of bentonites from many sections of the United States were studied in the course of this investigation.

Bentonite is a rock that contains 75 percent or more of the crystalline clay-like minerals montmorillonite or beidellite, state C. W. Davis, associate chemist, Bureau of Mines, and H. C. Vacher, graduate research fellow, University of Nevada, in Technical Paper 438, just published.

For a long time, investigators have recognized the occurrence of a peculiar clay-like substance which, when wet with water, resembled soft soap and was called "mineral soap" or "soap clay." Early reports show that such mineral had long ago been used at the Hudson Bay posts in Canada for washing blankets.

The first shipments for commercial purposes were made in 1888 by William Taylor of Rock Creek, Wyo., after whom the material was called "taylorite." In 1898, however, it was learned that the name taylorite had already been used as a mineral name for potassium ammonium sulphate, so that this substance was then designated as bentonite from its occurrence in the Fort Benton formation of the Rock Creek district.

Of the many uses suggested only a few have been tested, and investigators have not worked out the properties of bentonite that determine its usefulness or made tests to determine what type of material is best suited to the different uses.

Bentonite deposits occur in beds from a few inches to many feet thick, mainly in the Tertiary but to some extent in the Paleozoic and Mesozoic rocks in many parts of the United States and Canada, and deposits have been reported from Mexico, China, and France.

The bentonite of Wyoming is usually considered a standard type in studying other so-called bentonites. One of the important producers of the material has deposits at Medicine Bow and a grinding plant at Cheyenne. Another important producer in Wyoming has a mine at Clay Spur, near Newcastle. A large new deposit of bentonite has recently been reported in Johnson County.

The largest known California bentonite deposits occur in the arid desert region along the Amargosa River in Inyo County. What is possibly an extension of the Wyoming bentonite occurs near Belle Fourche, S. Dak. On claims owned by one company at this place, there is estimated to be millions of tons of high-grade bentonite. Many other deposits have been found in Nevada, New Mexico, Idaho, Tennessee, Kentucky, Alabama, and other states.

The results of this investigation are given in Bureau of Mines Technical Paper 438, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 10 cents per copy.

STRATEGIC WAR MINERALS*

By COL. CHARLES B. ROBBINS†

One Of Duties Of War Department Is To Insure To Nation A Supply In Time Of War Of Those Metals Known As "Strategic War Minerals"—Co-operation Of Mining Industry Urged In Finding Substitutes, In Augmenting Domestic Production, And In Otherwise Assisting In Meeting The Need

THE American Mining Congress, with the mission of promoting the best interests of the mining industry, must essentially be of great benefit not only to this industry and the mining profession but to the Nation at large, whose general prosperity is dependent on the prosperity of the units of which it is composed. The products of the mines represent so great a part of the national wealth as to give to this Congress abundant opportunities to serve the general good.

Col. Charles B. Robbins

A national organization such as this must be conscious that among its many opportunities for service none is more important than that of being prepared, if occasion demands it, to give its utmost aid in the national defense of this country.

The National Defense Act places on the Assistant Secretary of War, among other things, responsibility for the assurance of adequate provision for the mobilization of material and industrial organizations essential to war-time needs. In the fulfillment of this duty the Assistant Secretary of War must look to many sources for help, and the American Mining Congress can be one of the most important of the helping hands.

Plans are now being made for the solution of the problem of procurement which will confront the United States in time of war and sufficient progress has been made to assure us that, with the cordial and sympathetic cooperation of our industrial leaders, a readjustment of industry from a peace-time to a war-time basis can be rapidly effected with a minimum of confusion. When this readjustment has been made and when our industrial plants, expanded and transformed as they must in some cases be, have had time to come into mass production of munitions, there can be little fear of a failure in military supply, provided our plants are themselves supplied with the raw materials which they will require.

We are fortunate in that most of our raw materials are of domestic origin, but, kind as nature has been to us, she has not endowed us with a supply of everything needed in commercial industry nor in modern warfare. We are, therefore, compelled to go abroad for many of our raw materials, and if we are no longer able to go abroad, if by the conditions of war our foreign trade is temporarily destroyed, we shall be compelled to resort to stringent measures to prevent our industry being paralyzed by a famine in those "strategic raw materials" which enter into the composition of modern munitions.

Among the minerals those which are classed as strategic are tin, chromium, manganese, mercury, antimony, mica, nickel, and tungsten. These are either not produced in this country at all or are produced in quantities inadequate for our needs. To avert a threatened famine there are four steps which might be taken.

First—By exercising strict economy and curtailing or abolishing unnecessary uses.

Second—By finding materials of domestic origin which can be substituted for those minerals which are not to be had in quantity.

Third—By augmenting domestic production.

Fourth—By procuring and storing in peace time an adequate supply to carry us through a period of emergency.

The first of these methods will, of course, be applied as fully as possible. In time of peace, when materials of every kind are abundant, the military service, like everyone else, indulges in a few luxuries which are not indispensable. Felt hats are comfortable and are nice looking, but mercury is required in their manufacture. As long as mercury is available in quantity, we shall continue to wear our felt campaign hats, but when the supply threatens to become short we shall discard that hat for one which does not require the use of any strategic raw material. Other nonessentials will go the same way. We have planned to strip ourselves immediately of all dispensable articles which involve the consumption of materials in which a shortage is threatened. It is not anticipated that there will be any difficulty in getting our civilian population to do likewise. There is no doubt that when it is shown to the American people that a rigid economy in certain lines is necessary, that economy will be most cheerfully exercised.

The second step, that of finding substitutes, is now being taken with respect to many articles on our strategic list. The development of a detonator, equivalent in action to mercury fulminate but requiring no material not domestically obtainable, is proceeding with every prospect of complete success, and promises greatly to reduce our need for mercury.

An outstanding accomplishment has been the reduction in our requirements for antimony. This metal is used in munition making, principally for the production of hard-lead shrapnel balls and small-arms bullet cores. Investigations at our arsenals and proving grounds have demonstrated that an alloy of lead with barium and calcium is an entirely satisfactory substitute for antimonial lead for these purposes. This alloy, known as "Frary metal," can readily be produced from materials of domestic origin. By means of this substitution our antimony requirements for a two-year period of warfare have been reduced from about 45,000,000 pounds to about 2,500,000 pounds, a quantity which it is within our ability to produce.

Much work has been done looking to the provision of substitutes for tin in its manifold uses. By replacing bearing metals and solders containing tin with alloys containing little or no tin, we have been able to reduce our figures for direct military requirements of tin for two years from 20,000 to about 15,000 tons. The work which is now in progress on food containers promises ultimately a much larger reduction.

* Presented to 31st Annual Convention, The American Mining Congress.
† Assistant Secretary of War.

Until recently tungsten has been regarded as absolutely essential to the production of high-speed tool steel, but work which has been done by our molybdenum producers and at Watertown Arsenal by our Ordnance Department leads us to hope that some day we may be able to eliminate practically all of our requirements for tungsten in tool steel. It is believed that when the technique of manufacture has been adequately worked out we shall be able to make perfectly satisfactory cutting tools of a molybdenum alloy to replace the present tungsten alloy. The molybdenum tool is fully as satisfactory as the tungsten tool. In fact, the molybdenum tools that have been used in the shops at Watertown Arsenal have been preferred by the workmen to the tungsten tools. We have, however, still to perfect a process which will assuredly make every molybdenum steel tool as satisfactory as every other molybdenum steel tool. If this substitution is made we can reduce our requirements for both direct and secondary uses by at least 40 percent.

With respect to nickel, it is interesting to note that while we formerly specified nickel steel for all artillery we now find that substitution can be made on nickel steel with satisfactory results, up to and including the 155 m/m gun. This, of course, effects some reduction in our requirements for nickel.

Other instances might be cited, but these are sufficient to indicate the very valuable results which may be expected from a thorough study of the possibilities of substitution. As yet our study along these lines has been by no means exhaustive because we have never had sufficient funds for the work. In fact, the current budget is the first one to carry estimates made specifically for this purpose. This work must be done primarily by the War Department, for the difficulties encountered are not generally due to a lack of chemical and metallurgical knowledge, so much as to the fact that we must determine the applicability of certain substitutes, already well known, to military uses, which in so many instances can not be judged by the same standards as the commercial uses. Cost of production is one of the most vital factors entering into the determination of which of two equally suitable materials will be commercially used. Commercial industry is therefore not interested in a substitute which is even slightly more expensive than the material for which it is to be substituted. The Army, however, is very much interested if one of these materials is obtainable in war time while the other is not. In such a case a slight excess in cost would be of no moment if it resulted in the continuation of the flow of military supply which might otherwise be interrupted.

A similar problem confronts those of our industries which are engaged, even in war time, in the production of commercial articles for the nonmilitary uses of our general population. If a shortage in strategic minerals is forced by war they will be compelled either to stop production or find substitutes. The American Mining Congress might very profitably devote much thought to a study of the extent to which materials of domestic origin may, in an emergency, be substituted in our general industrial practice for those minerals which we may not be able to obtain.

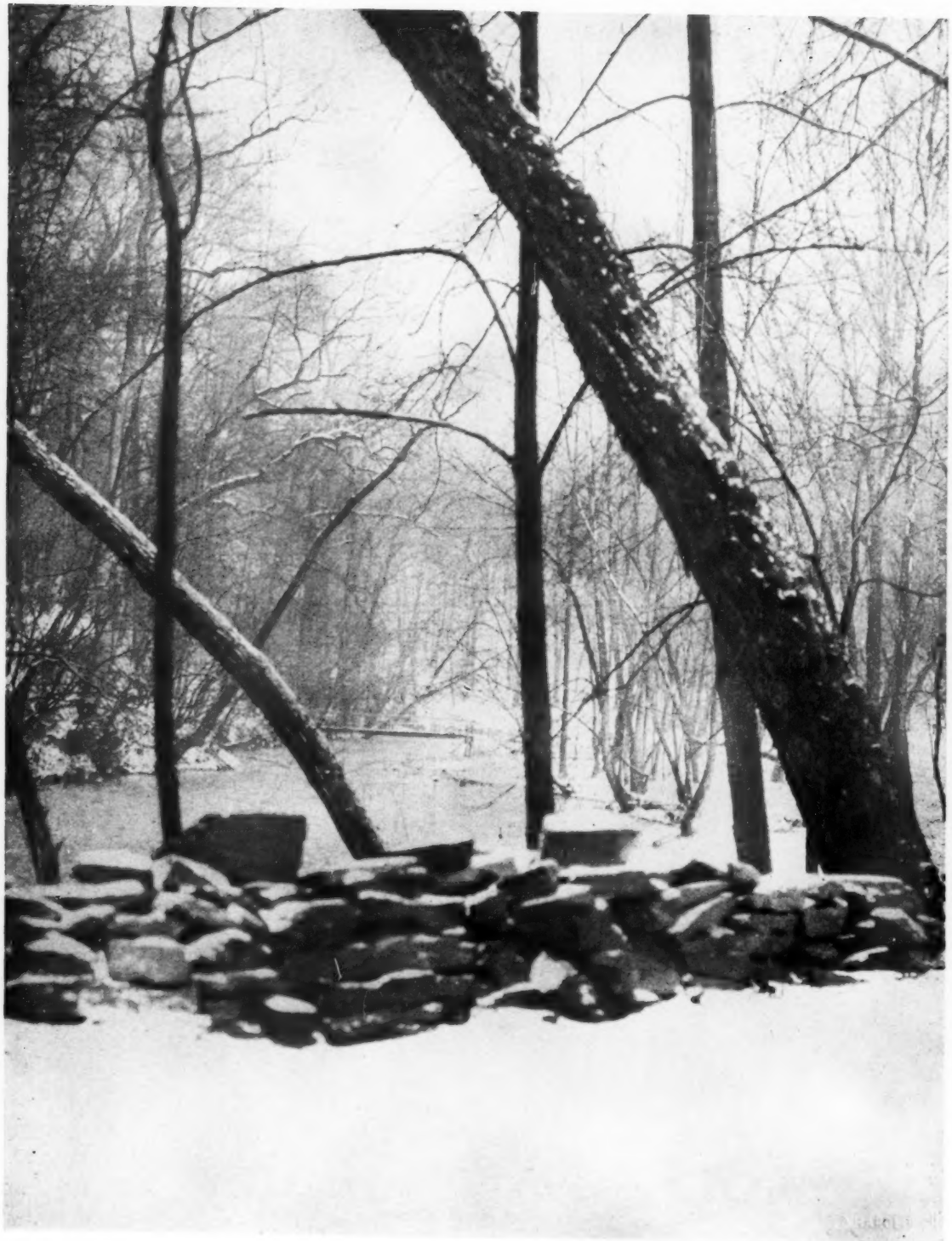
The third step, that of augmenting our domestic production, is practicable in varying degrees. With the assistance of the Department of Commerce, the Assistant Secretary of War is listing all domestic sources of materials for which we now depend mainly upon imports and is carefully estimating the degree to which production from those sources might be stimulated under the goad of war emergency. Many of our mines which are more or less neglected now because they can not compete with cheaper production from abroad may be developed into important producers when competition from the richer sources is shut off. Any information which the members of the American Mining Congress may be able to give us relative to the discovery and development of new sources of strategic minerals will materially assist us in estimating the resources available to us in war.

The fourth step, the procurement of a war reserve of strategic raw materials sufficient to carry us through a period of emergency, is one which the United States has never taken. A definite policy as to such a reserve can not yet be recommended because the possibilities of substitution have not yet been completely investigated. But whatever the governmental policy may be, there is naturally at all times a reserve of some magnitude in the hands of our industry. The size of this reserve fluctuates. Sometimes it is greater than normal, sometimes it is less. It is reasonable to believe that, at the outbreak of war, the reserve will be above normal. War seldom comes without warning, and when its clouds begin to gather our industrial leaders, for their own protection if from no other motive, will naturally try to prepare for the storm.

The War Department, through its procurement branches, is planning by means of economy, substitution, the augmentation of domestic supply, and possibly by a war reserve, to prevent the paralysis of our military effort through a failure in the supply of strategic raw materials. The American Mining Congress can be of invaluable aid, not only in some degree to the War Department but in immensely greater degree to the country in general, if it will institute similar studies in the field of the nonmilitary uses of those minerals. To what extent can economy be exercised without hardship? What substitution is it practicable to make? How much can domestic supplies be augmented? Taking all factors into consideration, how much reserve of each material should be kept on hand by our industries? An appreciation by each industry of the situation which will confront it in war and intelligent planning to meet that situation by insuring the possibility of its continued operation will not only contribute to our military success but will minimize the confusion disruption which might otherwise ensue.

SYSTEMATIC TIMBERING LESSENS HAZARDS OF ROOF FALLS

An intensive study of the causes and means of the prevention of falls of mine roof and coal, which are responsible for nearly half the accidental deaths in the coal mines of the country, is being conducted by the Department of Commerce, through the United States Bureau of Mines. The engineers of the bureau's Pittsburgh Experiment Station, who are making this study often observe conditions, practices and methods that give promise of safeguarding the miners against accident by falls of roof. Notable among these may be mentioned systematic methods of placing timber for the support of the roof, particularly at and near the working places where there is the greatest hazard from falls of roof, and where 85 to 87 percent of all fatalities occur from falls. This system of timbering involves placing props in rows 4 ft. apart, the props also being 4 ft. apart, extending to within 6 ft. of the working face before the coal is shot down. Before beginning to load the coal a "safety prop" is placed at the point where the miner will stand while shoveling the coal, and as he advances in the loose coal additional props are placed each 4 ft. Where draw slate does not come down with the coal, 2 lines of props are placed across the face as the coal is removed, so at no time will the miner be under roof not protected by props not more than 4 ft. apart. In all cases the props have cap pieces 3 to 4 in. thick, 18 to 20 in. long, and 5 to 6 in. wide. Upon completion of the loading of the coal the props supporting the draw slate are removed by a mechanical post-puller and permanent props are placed, leaving room for the coal-cutting machine at the face. Where the span for the use of the machine is considered unsafe, collars are temporarily installed.



Rock Creek Park in winter

FOREIGN MINING TAXES *and* DOUBLE TAXATION RELIEF*

By MITCHELL B. CARROLL †

Methods Of Taxation Of Minerals In Foreign Countries Outlined—Double Taxation Results—Suggestions For Relief Work—Work Of Model Conventions Outlined

I. FOREIGN MINING TAXES

IN practically every country where mines or oil wells exist, special provisions concerning them are found in the national tax laws. In a number of countries the subsoil deposits are government property and the right to exploit them is conceded under particular conditions. In Great Britain, Canada and Germany the profits of the mining enterprise are subject to the national income tax law, but the details of the dispositions, and notably those concerning allowances for depletion differ widely. In France and many of the Latin American countries the taxation of mines is governed by separate laws, and is imposed, broadly speaking, on the dual basis of surface and production.

Mitchell B. Carroll

So varied are the dispositions concerning mine taxation that an attempt will be made to describe only the principal levies, and primarily those affecting the profits of the enterprise. The sundry taxes incidental to exploration, stamp duties, consumption and export taxes and the like that may be encountered, especially in Latin America, are simply mentioned here before passing on to the more fundamental imposts.

British Mine Taxation—No Depletion Allowance

In comparing foreign tax systems with our own, one looks traditionally to Great Britain, which has not only the oldest income tax but some of the oldest mines under exploitation. Formerly the profits of coal, copper, iron and other mines were assessed on the average of the five preceding years, but they are now taxed according to the uniform basis of the preceding year. In this connection profit means "the entire profit derived from the mine, deducting the cost of working it, but not the cost of making it" (Coltness Iron Co. *v.* Black, 1881, 6 A. C. 315, at p. 326). This decision accords with the general principle that in computing profits for the purposes of the British income tax, capital gains are not in general included and capital expenditure is not allowed as a deduction.

All attempts to preclude the application of this principle to mines have failed. The courts have disallowed a claim to deduct the actual value of the coal exhausted during the year from the receipts derived from selling the coal (Inland Revenue *v.* Farie, 1878, 6 R. 270). A mine owner can not deduct from the gross earnings of his mine in a particular year an amount representing that year's depreciation of all the pits in the mines wherever sunk (Coltness Iron Co. *v.* Black, 1881, 6 A. C. 315).

The refusal to allow for depletion in the case of mines was upheld by the report of the royal commission appointed in 1919 to study income tax on the ground that if the owner were "granted an allowance sufficient to enable him to replace his capital when the mine is exhausted, it would be inequitable to refuse an analagous allowance in respect of the initial capital invested in the education and training of a lawyer or surgeon or workman, whose earning power is possibly of shorter duration than the life of the mine." It was found impossible, therefore, "to make any general recommendation that from the income produced by any asset an allowance should be made for the amortization of its capital value."

In case Parliament should ever grant an allowance, the commission believed that a time limit should be placed on the recognition of wastage, taking into account only that "which is important when considered in relation to human life and human expectation." As contingencies happening after the lapse of a period of time exceeding 35 years do not appeal very greatly to the mind of the average individual, no allowance should be made when the life of the asset is to be 35 years or longer. Assets with a shorter life should receive an allowance dependant on the time which their life falls short of 35 years.

Canada Allows for Depletion

Although an offspring of the British system, the Canadian income tax allows for depletion in the case of mines. Under the Dominion act the Minister of Finance may make such an allowance for the exhaustion of mines and oil wells as he may deem just and fair (Act of 1923, sec. 5).

Similar provisions are contained in the income tax laws of the Provinces of British Columbia and Manitoba. The section in the law of the latter province is the same as that in the Dominion act. Under the British Columbia law, capital expenditures are in general not allowed as a deduction nor is "any amount expended in the development of a mine, except such amount so expended as may in the discretion of the minister be allowed as a deduction, having regard to the amount of ore actually mined and shipped from which the income is derived" (Consolidated Tax Act, 1926, sec. 44 (l), (g), (n).

The British Columbia act further provides that every owner of a mine shall be assessed and taxed on his income from the mine or on its output, whichever tax is greater in amount (sec. 79). In the case of mines taxed under this section the Finance Minister may within his discretion grant an allowance for depletion or exhaustion (sec. 44 (1) (o)).

Germany Also Allows for Depletion

The revised German income tax laws of 1925 contain some of the most advanced provisions in respect of depletion allowances. In general, mining enterprises are subject to income tax in the same manner as commercial undertakings, but they are specifically accorded a deduction for exhaustion of assets (Substanzverringerungen). Although the

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* Presented to 31st Annual Convention of The American Mining Congress.

† Chief, Section of Taxes and Corporations, Department of Commerce.

fundamental rule is that such deductions shall be proportional to the life of the mine, it is recognized that the rate of depletion depends essentially on the actual output which may vary from year to year. This fact is to be taken into account in computing the annual deduction.

The following formula was proposed in a decree of the Finance Ministry (RFM III, 1900, v. April 3, 1926) for use in calculating the depletion allowance (Evers, Kommentar sum Korperschaft-steuergesetz, pp. 620, 621):

$$X = V \times \frac{M}{S}$$

X representing the deduction for the year;
V representing the value entered in the tax balance sheet at the beginning of the tax year for which the property is first assessed;
M representing the amount of the ore mined in the year;
S representing the amount of the ore existing at the beginning of the year.

French Tax on Surface and Profit Basis

Turning to the mining taxes in France, one encounters an entirely different system. It was introduced in 1810 and has since been amended in certain respects, but remains apart from the method of assessing ordinary commercial enterprises for income tax purposes. The tax comprises a fixed rate (redevance) and a proportional rate. The fixed rate of 1 franc per hectare of the surface occupied is due beginning with the third year after the commencement of the concession. The proportional rate is 25 percent of the net product of the past calendar year.

The method of calculating the net product depends upon the juridical nature of the enterprise. Mining companies with a share capital pay for the proportional tax on the total amount distributed to shareholders in the course of the preceding year, in the form of dividends or otherwise than as a total or partial reimbursement of capital. Enterprises not under this regime pay the tax on the basis of the excess of receipts over the expenditures of the preceding year, as assessed by the administration.

Latin American Taxes Primarily on Surface and Production

In Brazil and most of the other Latin American countries the mining taxes are substantially similar to the French levies, comprising a fixed rate per unit of surface and a proportional rate, varying in character, on the product. Bolivia and Mexico have both recently adopted special mining tax laws, which are treated more fully below. Columbia is considering the revision of its present legislation.

Chile subjects mining enterprises to an annual rate per hectare and an income tax, Ecuador to an annual land rental and an annual royalty representing a certain percentage of the gross production. Under the Venezuelan Mining Code, an oil company pays an annual tax based on the number of hectares of ground occupied. When production commences, the enterprise pays a tax of 10 percent of the market value, with a minimum of Bs. 2.00 per metric ton of oil produced.

Bolivia imposes, in addition to an annual tax on mining concessions of about $7 per 100 hectares, a tax on net profits progressing from 4 percent on earnings which are 5 percent or less of the capital invested to 50 percent when the earnings are 150 percent of the capital or over. The very detailed law of November 23, 1923, which authorizes the income tax on mining companies, also grants them an annual deduction up to 5 percent of the value stated in the balance sheet on December 31, 1922, subject always to fiscal rectification. An allowance of 10 percent of the value stated in the balance sheet on that date is granted in respect of machinery for the treatment of minerals, machine shops, aerial tramways, motors and motive power plants.

Mexico Has Recent Mining Tax Law

The Mexican Federal Government imposes three kinds of special taxes on mining by virtue of the law of April 30, 1927, namely (1) a tax on the surface extent of mining claims; (2) on the production of ore and metals; and (3) fees for smelting, coining, and assaying. States and municipalities are forbidden to impose any kind of tax on the mining industry, except to levy a maximum tax of 5 per 1,000 per annum on the value of metallurgical plants. The federal government also collects a surtax of 10 percent.

The annual surface tax is payable according to a scale of pesos per "pertenencia"—a "pertenencia" being defined as a "solid of indefinite depth, bounded on the surface by the four vertical planes corresponding to a horizontal square 100 meters to the side." For example, on a tract of 100 or more pertenencias, the rate is 18 pesos per annum.

The percent rates of the production tax vary with the nature of the ore or metal mined; for example, that on gold is 8.5 percent of its value, that on copper ore 2 percent.

The petroleum industry is subject to a production tax and an export tax. The rate of the former varies with the density of the petroleum. The export tax on petroleum has a scale of rates per cubic meter varying with the nature of the product. For example, fuel oil pays 0.80 peso per cubic meter at a temperature of 20 degrees Centigrade.

The production of petroleum on federal lands is liable to a scale of royalties progressing from 5 to 15 percent.

Under article 13 of the income tax law individuals or corporations exploiting federal government concessions in which the government does not share in the profits, with the exception of federal concession banks, are liable to an income tax progressing from 3 to 9 percent of their net profit.

II. Double Taxation Relief

The establishment by American companies of mining enterprises abroad or the holding of shares or bonds issued by foreign mining companies frequently entails liability to foreign as well as domestic income taxes. Double taxation results.

Certain relief against this cumulation of taxes is provided in the United States revenue act, but from a world viewpoint double taxation exists to a very discouraging extent. It is therefore appropriate at this point to summarize what is being done internationally to make it possible for twentieth century Jasons to bring back the golden fleece without having to share most of it with tax collectors both abroad and at home.

Progress in International Double Taxation Relief

Conventions intended to serve as models for states desiring to eliminate the double taxation of international trade and investments were adopted at a conference in Geneva, October 22-31, 1928, composed of experts representing 27 of the important commercial countries. Three of these standard bilateral conventions preclude the levying of income taxes both in the country where the income originates and again in the country where the recipient resides. A fourth restricts multiple liability to death duties. The fifth and sixth conventions deal with mutual administration assistance in the assessment and judicial assistance in the collection of taxes. These conventions are intended to serve merely as guides to countries desiring to conclude double taxation treaties and are not in any sense binding on the governments represented at the conference.

Realizing that the adoption of model conventions stating general principles was but a first step in achieving the end desired, the conference voted that a permanent organization be established under the auspices of the League of Nations to carry on the work begun. (The American expert, for obvious reasons, abstained from voting on this proposal, as well as the measures concerning death duties and administrative and judicial assistance.)

Reasons for Conference

Prior to the World War, when the rates of income taxes were relatively low, trading and investing between nations was not hindered by subjection to income tax both in the foreign country where business was carried on or where money was placed in stocks, bonds or real estate, and

again in the country of the owner's residence.

With post-war rates soaring, in many instances to almost confiscatory heights, the obligation to pay such taxes in two countries on the same income obviously presented serious barriers to the much-needed resumption of international business relations.

Examples of Double Taxation

At the worst, an individual residing in one country and receiving income from another was liable to taxes in both countries mounting to over 100 percent of the income involved. Even today the cumulation of taxes can consume over half the income. For example, if a British subject owns shares in an English company which has a sales establishment in the United States, the income derived from America is subject there to 12 percent corporation tax, then to the British standard rate of 20 percent, and finally, in the hands of the shareholder, to the British surtax which rises as high as 30 percent.

A German citizen having a branch of his business in London is liable there to the standard rate of 20 percent plus the surtax of 3¾ to 30 percent, and to the German tax from 10 to 40 percent.

If the same German owns shares in a local Aktiengesellschaft (corporation) which has a sales branch in Paris, the French profits, before reaching the shareholder, run the following tax gauntlet: (1) The French net profits tax of 15 percent, and (2) the dividend tax of 18 percent on that part of the dividends distributed in Germany which is deemed to be derived from the establishment in Paris; then (3) the German corporation tax of 20 percent, and (4) the dividend tax of 10 percent which is credited against (5) the shareholder's tax on total income, ranging from 10 to 40 percent.

Steps Taken Prior to Geneva Conference

Since 1920 the League of Nations and the International Chamber of Commerce, through committees of economists and technical experts, have been endeavoring to formulate a scheme for removing this barrier to the development of trade and free circulation of capital. In April, 1927, technical experts at a meeting in London drafted four model bilateral conventions: (1) For the prevention of double taxation in the field of taxes on income and wealth; (2) for restricting multiple liability to death duties; (3) for administrative assistance in the assessment; and (4) judicial assistance in the collection of taxes.

These four model conventions were referred to virtually all the governments of the world, with an invitation to study them and to send governmental experts to attend a conference to be held in Geneva, beginning October 22, 1928. Prof. T. S. Adams, former economic adviser to the Treasury Department, was appointed as the expert to lead the American delegation.

Gist of London Income Tax Convention

The most important model convention drafted at London, April, 1927, was that concerning income taxes, and its consideration consumed almost the entire time of the Geneva gathering. In view of the wide differences in the various income tax systems, the bilateral treaty had been chosen as the form most adaptable to the respective tax systems of two countries. The convention regarding income taxes envisaged the existence in each contracting state of a tax system analogous to that in Italy, namely, an income tax composed of several flat rates on specific kinds of income on sources from within the territory of a particular state, and a progressive complementary or surtax on residents in respect of their total income. The flat rate taxes being imposed on specific kinds of income from local sources were called "impersonal" taxes. The graduated tax on the person resident in the territory of a state on the basis of his total income from all sources was termed a personal tax.

The plan presupposed, therefore, the coexistence of impersonal and personal taxes in each of the contracting states. In general, the country in which certain kinds of income were defined as having their origin was to levy its respective impersonal taxes thereon, but not its personal tax. On the contrary, the country in which the recipient has his fiscal residence was to forego collecting its impersonal taxes on the foreign income but was to have such income included in the total income of resident taxpayers for the purposes of the personal tax.

An additional advantage was given to the country of origin; in derogation of the principle concerning personal taxes it could impose its personal tax on income from real estate and business establishments belonging to nonresidents.

In short, most of the sacrifice of revenues to assure relief from double taxation was to be borne by the state of residence. The provisions preponderated in favor of debtor countries as a concession to creditor countries, it was recognized that, budgetary needs permitting, the state of origin might refund its impersonal tax on interest paid to persons resident in the other state, which could impose tax thereon.

American Expert's Proposal at London Meeting

Realizing the difficulties that might be encountered in applying the terms "impersonal" and "personal" to the American as well as many other systems consisting primarily in what might be called a general income tax, Professor Adams, the American expert, submitted at London an alternative draft convention not employing that classification. In accordance with the American system of relief, he provided that the state of residence of the taxpayer would grant relief against its tax in respect of income arising in the other contracting state and taxable there under the agreement.

This system of relief was taken as the basis for provisions embodied in article 10, concerning personal taxes, of the model convention adopted by the committee in the hope that the project would be acceptable not only to countries having both impersonal and personal taxes but also to those having only a general income tax.

Tendencies at Geneva Conference

The differences of opinion between technical experts at the London meeting concerning dividends and interest and the application of the convention to countries having different systems of taxation developed into real issues at the Geneva Conference of governmental experts.

The London convention was considered inapplicable to their own situations by a large proportion of the 27 governments represented at the Geneva meeting in October, 1928, because the convention was based on a distinction between impersonal and personal taxes. They were unale to employ the clasification of impersonal and personal taxes as a common denominator in fixing the equation of relief as between their own tax system and that of a neighboring country. Hardly had the Geneva Conference begun when a strong sentiment manifested itself in favor of framing an alternative project disregarding those terms.

This movement was strengthened by its union with another sponsored by the two great creditor nations, America and Great Britain. As already mentioned, Professor Adams, in the previous meeting, had pointed out the unadaptability of the committee's original plan to a country such as the United States having only a general income tax. The low normal rate of 5 percent could not be assimilated to the European "impersonal" tax rates, which range from 10 percent to 36 percent. Furthermore, a division of tax being impracticable between such countries, a convention between them is not truly reciprocal, unless each gives up its tax on certain items of income in favor of the other.

The American expert contended the taxation of interest and dividends at the domicile of the creditor or security holder—just compensation in return for yielding to the country of origin the right to tax trading profits, real estate rents and most of the other important kinds of income produced in its territory. These views concorded with those of the experts of other creditor countries.

The representatives of various other states (primarily debtor), while not enamoured of the terms "personal" and "impersonal," were adamant with respect to maintaining the present practice of taxing interest and/or dividends by deduction at the source.

Alternative Conventions Proposed by German, French and American Experts

During the long discussions on draft convention No. 1, alternative proposals were submitted by Professor Adams, Dr. Dorn of Germany, and Monsieur Borduge of France. Dr. Dorn proposed a draft which defined sources of income granting the exclusive right to tax most of them to the country of origin. It stated that, in principle, income from securities should be taxable at the domicile of the recipient, but in the following paragraph authorized a country imposing a tax by deduction at source on such income (e. g., Germany) to continue to do so, thus nullifying the preceding clause.

Another model convention disregarding the terms "impersonal" and "personal" was proposed by Monsieur Borduge, but was subsequently amalgamated with the Dorn draft (designated hereafter as the Dorn-Borduge proposal).

The project of the American expert stipulated that in general the country of domicile was to have the right to tax, but recognized the right of the country in which income originates to tax, by priority, certain specified sources. These included practically all the items assigned to origin by the London convention except interest, dividends, and private pensions and unspecified items which were to be taxable at domicile.

Thus the country of domicile retains its right to compute its tax on the total income, but grants against such amount a deduction in respect of the income taxable in the other contracting state. This deduction is equal to the lesser of the following amounts: (a) Either the foreign tax paid, or (b) a part of the tax on total income representing the proportion which the foreign income bears to total income.

This project permitted the country of origin which imposes a tax on income from bonds and stocks by deduction at source to collect the tax thereon as usual, but to refund the tax on presentation of proper evidence as to the non-residency of the security holders.

London Convention Modified and Adopted

Out of the long and animated debate, the London convention emerged stripped of the provisions that had been inserted in 1927 to take care of the creditor countries with a general income tax. Interest is to be taxable only in the country of the debtor. (Article 3.) States having only a general income tax are not covered in article 10.

Draft convention 1 is now applicable exclusively to countries having a system of impersonal and personal taxes. Its original symmetry is restored. The only exception to the rule of personal taxes being levied at domicile is the provision in the new second paragraph of article 10 requiring the country of domicile to grant a certain deduction against its personal tax where the country of origin collects its personal tax rates on income from immovable property or from industrial, commercial or agricultural undertakings situated within its territory.

In accordance with the principles adopted at the London meeting, immovable property and mortgages are subject to impersonal taxation where the real estate is situated; dividend and directors' percentages at the real center of the management of the company; industrial, commercial, agricultural undertakings, trades and professions, wherever there are permanent establishments (this term including mines and oil works), private salaries where earned, government salaries and pensions in the country of the debtor; annuities and income not otherwise specified at the domicile of the recipient.

The only addition of importance is the assimilation of air navigation to maritime shipping, the income therefrom being declared taxable at the real center of management of the enterprise.

Adoption of Alternative Conventions

As the London convention thus modified was no longer acceptable to the majority of countries represented, a special committee was appointed to consider the adoption of the Adams and Dorn-Borduge proposals. After sitting late into the night and modifying their language in certain respects, the subcommittee approved them. The next day they were adopted by the Conference, the Adams proposal as convention No. II and the Dorn-Borduge as convention No. III.

The three conventions are substantially alike in the language defining the kinds of income taxable at origin.

Their essential points of differences are the following: (a) Convention No. I (London) is based on the distinction between impersonal taxes and personal taxes, granting, in general, the right to levy the former to the country of origin, and the latter to the country of domicile. Practically all kinds of income are liable to impersonal taxation at origin. Interest is taxable in the country of the debtor, dividends at the real center of management of the company paying them.

(b) Convention No. II (Adams) makes no classification of taxes under the heads "impersonal" and "personal" or otherwise. Article I states that the country of domicile of the person shall, in principle, tax all kinds of income, but article II authorizes the country of origin to impose its tax by priority on certain kinds of income, notably that from commercial or industrial establishments within its territory and salaries earned there. Income not specified, especially interest and dividends, shall bear tax only at the domicile of the recipient. The country of domicile, upon receiving a declaration of total income, shall give a credit against its tax computed on total income in respect of the tax paid at origin.

(c) Convention No. III (Dorn-Borduge) similarly does not employ the terms "impersonal" and "personal"; allots most kinds of income to the country of origin, although it states that income from securities shall be taxable at the domicile of the recipient; it allows a country having a source tax on such income to continue to levy it; and requires the state of domicile to either refrain from levying its special tax on such income or deduct the foreign tax therefrom. Special agreements are foreseen authorizing either the refunding of the origin tax to a nonresident or the crediting of the origin tax against the tax at residence.

Utility of the Model Conventions

What is the utility of the model conventions? In the first place, they represent the consensus of the opinion of the governmental experts of 27 countries—most of whom had official instructions—as to the best method to be followed to remove the artificial barriers and international business relations resulting from double taxation.

These model conventions establish a set of principles substantially uniform in effect, except as regards dividends and interest. The principles contained therein have already been embodied to a large extent in double taxation treaties concluded by various European states to encourage commerce between their nationals. Such countries are Austria, Czechoslovakia, Germany, Hungary, Italy, Jugoslavia, the Netherlands, Poland and Sweden. Great Britain and the Irish Free State have agreed that income derived from one country by a person residing, or corporation controlled in the other, shall be taxable only in the latter state.

Measures Taken by the American Government

The United States has been a pioneer in granting relief from double taxation. In 1918 it offered its citizens and corporations a certain credit against the American tax for taxes paid abroad on foreign income. (*Continued on page* 121)

LEGISLATIVE REVIEW

Session Of Congress Active In Disposing Of Pending Legislation—Senate Interstate Commerce Committee Hears Arguments On Proposed Coal Legislation—Colorado River, Convict Labor And Land Title Bills Passed—House Ways And Means Committee Begins Hearings On Proposed Revision Of The Tariff To Be Undertaken At Extra Session This Spring—Reform In Tax Refund Procedure Recommended

WITH the present session terminating by law on March 4, Congress is busily engaged in disposing of many legislative proposals. The work of Congress is also being marked by committee activity in an effort to dispose of pending proposals before the present Congress closes. All bills unacted on before the close of this session will automatically expire with the end of the Congress and will have to be reintroduced and reconsidered in the new Congress. The Colorado River development bill was finally enacted and approved by the President as was also a bill granting title to public lands held under claim or color of title for more than 20 years. Congress also completed action on a bill to forbid interstate commerce in goods mined or produced by convict labor.

Consideration of proposed legislation regulating the bituminous industry was resumed by the Senate Interstate Commerce Committee, and most of the witnesses objected to the legislation on the ground that it would do more harm than good. This opposition was expressed by representatives of the retail coal interests, Ohio coal operators and railroads. Because of the short time remaining in this session, it has been conceded that no legislation on the subject is possible before March 4 and the whole matter will go over to the new Congress.

Active preparations for revision of the tariff at an extra session of Congress, which is likely to be called in April, are being made by the House Committee on Ways and Means. Beginning January 7 the committee heard representatives of the mining and other industries who advocated either retention of present duties or increases in tariffs on a large number of mineral products. The American Mining Congress made an appearance at the hearing in behalf of duties on 26 minerals and also endorsed recommendations of various other mineral producers for adequate tariff duties. The hearings bfeore the committee will not be concluded until late in February after which it will prepare a new tariff bill ready for action by the House early in the contemplated extra session. Congressional leaders are hopeful that the new tariff law will be enacted by early July.

Recent large refunds of taxes by the Internal Revenue Bureau started an agitation in Congress for review of tax returns by the Board of Tax Appeals and a bill to this effect was reported by the Senate Judiciary Committee.

A number of new mining measures were introduced during the past month, among them bills to permit court review of war mineral claims, amending the mining laws applicable to national forests by restricting mining rights in such lands to the mineral deposits; extending section 18a of the mineral leasing law to certain lands in Utah, to investigate the disposition of lands ceded to the United States by Mexico, granting land for a miners' hospital in Utah, to investigate Indian affairs, to define a Federal and state water power policy, for construction by the Government of transmission lines and the disposition of the power from the Muscle Shoals project in Alabama, to develop and lease power from Indian irrigation projects, and to establish uniform requirements affecting Government contracts.

The following is a summary of new bills and action on old bills taken during the month:

Mineral Patents

H. R. 15919. Mr. Douglas (Dem., Ariz.). This measure authorizes patents for lands containing at depth copper, lead, zinc, or silver and their associated minerals. Entries would be restricted to 640 acres to each individual or corporation under regulations of the Interior Department. Public Lands.

H. R. 15861. Mr. Vinson (Dem., Ga.). This bill would authorize appeals to the Supreme Court of the District of Columbia from decisions of the Interior Department in war mineral cases, if filed within one year from the passage of this bill. The decision of this court would be final. Mines and Mining.

S. 5348. Mr. Norbeck (Rep., S. Dak.). This bill amends the mining laws applicable to national forests by restricting mining rights to the minerals without any rights to the surface of the land. The bill would not apply to land in Alaska. The measure provides as follows:

"That hereafter mining locations made under the United States mining laws upon lands within a national forest shall confer on the locator no right to the surface of the land covered by the location other than the right to occupy, under the rules and regulations relating to the national forests, so much thereof as may be reasonably necessary to carry on prospecting and mining, and shall not authorize the taking of any resource other than the mineral deposits, or the occupancy of the land for any purpose other than prospecting and mining.

"That a patent issued hereafter under the United States mining laws affecting land within a national forest shall convey title to the mineral deposits within the claim; and the right, subject to rules and regulations governing such national forest, to occupy so much of the surface of the claim as may be required for extracting and removing the mineral deposits. Every such patent shall expressly reserve to the United States title to the surface of the land included in the claim or claims.

"That valid mining claims within the national forests existing on the date of

enactment of this act, and thereafter maintained in compliance with the law under which they were initiated, may be perfected under this act or under the law under which they were initiated as the claimant may desire.

"That the provisions of this act shall not extend to the Territory of Alaska." Public Lands.

S. 5269. Mr. Norbeck (Rep., S. Dak.). This bill is similar to the foregoing, except that it applies only to the Black Hills and Harney National Forests. Public Lands.

S. 3776. This bill authorizes patents to 160-acre tracts of lands held under claim or color of title for more than 20 years, on payment of $1.25 per acre. Enacted into law.

H. R. 13899. This bill is similar to the foregoing except that it applies to land in Michigan and gives claimants to such lands five years after its enactment to satisfy the Interior Department that they are entitled to the land. Reported by the Public Lands Committee.

S. 4691. This bill extends for one year from its approval the provisions of section 18a of the mineral leasing act to lands in Utah which were withdrawn on October 4, 1909. Passed by the Senate.

S. Res. 291. This resolution provides for an investigation by the Senate Public Lands Committee of charges that land ceded by Mexico to the United States have been fraudulently and corruptly turned over to private interests. Passed by the Senate.

Land Grants

H. R. 10157. This bill grants 100,000 acres of vacant, non-mineral, surveyed, unreserved public lands in Alaska for the benefit of the School of Mines and Agricultural College of that Territory. The lands are to be sold at not less than $5 per acre and timber and other products on the land are to be sold at their appraised value. Passed by the Senate.

H. R. 15732. This bill grants 50,000 acres of land for a hospital for disabled miners in Utah. The lands are to be vacant, non-mineral, surveyed and unreserved. Reported by House Public Lands Committee.

H. R. 15926. Mr. Crail (Rep., Calif.). This bill amends section 13 of the mineral leasing law by giving applicants for oil and gas permits not more than one year after receiving their permits in order to mark the corners and post notices on the land. The present law gives them 90 days. Public Lands.

H. J. Res. 374. Mr. Leavitt (Rep., Mont.). This resolution authorizes a committee of four Representatives and four Senators to investigate Indian affairs. Rules.

S. Res. 298. Mr. Frazier (Rep., N. Dak.). This resolution proposes to continue special investigations by the Senate Public Lands and Indian Committees until the end of the first regular session of the next Congress. Expenses.

S. J. Res. 167. This resolution authorizes Government counsel in the naval oil reserve lease prosecutions to conduct private practice before Government departments. Under this resolution O. J. Roberts, of Philadelphia, who had previously resigned, was reappointed as Government oil counsel. Enacted into law.

S. J. Res. 196. Mr. Thomas (Dem., Okla.). This resolution authorizes the President to negotiate with the Governors of Oklahoma and Texas to adjust land rights in connection with the interests of private parties caused by the Supreme Court decision in the Red River oil case. Judiciary.

H. R. 16166. Mr. Colton (Rep., Utah). This bill authorizes the use of public lands for grazing purposes by the stock-raising industry but stipulates that such use shall not interfere with the use of the land and water for mining purposes. Public Lands.

S. 5033. Mr. King (Dem., Utah). By request. This is similar to the foregoing. Public Lands.

Tariff Commission

H. R. 15654. Mr. Manlove (Rep., Mo.). This bill increases the membership of the Tariff Commission to seven members and prescribes that they shall be appointed without regard to political connections, but because of their special qualifications and fitness. One member each would be appointed from each of the following districts:

Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island.

New York, New Jersey, Delaware, Pennsylvania and Maryland.

Virginia, North and South Carolina, Georgia, Alabama, Florida, Mississippi and Tennessee.

Ohio, West Virginia, Kentucky, Indiana, Michigan, Illinois and Wisconsin.

Minnesota, North and South Dakota, Nebraska, Iowa, Kansas, Missouri, Montana, Wyoming and Colorado.

Louisiana, Arkansas, Oklahoma, Texas, New Mexico and Arizona.

Washington, Oregon, Idaho, California, Utah and Nevada. Ways and Means.

S. 5154. Mr. Norris (Rep., Nebr.). This bill creates a Court of Administrative Justice with 13 judges who shall consider cases now heard by the Board of Tax Appeals, Court of Claims, Court of Customs Appeals and district courts in cases involving claims against the Government. Judiciary.

Tax Refunds

S. 5319. This bill would require the Board of Tax Appeals to pass on tax refunds of more than $10,000. Reported by Judiciary Committee.

H. R. 15575. Mr. Hull (Dem., Tenn.). This bill amends the Federal Water Power act by more clearly defining and declaring the Federal and state water power policy. It gives the states authority over power projects within their borders. The bill recognizes the authority of the states to take over, operate or lease any water power project granted under the Federal Water Power Act. The states are also given authority to collect revenue for the use of waters for power in their borders. The Government could not authorize power permits or licenses unless approved by the states. State public utility commissions would regulate companies operating water power projects. The Interstate Commerce Commission would regulate such companies in case the state authorities are unable to do so. Interstate Commerce.

S. 5218. Mr. McKellar (Dem., Tenn.). This bill authorizes the War Department to build transmission lines and to dispose of power generated at Muscle Shoals, Ala. It appropriates $2,000,000. Agriculture.

H. J. Res. 370. Mr. Crisp (Dem., Ga.). This resolution authorizes the completion of dam No. 2 and the steam plant at nitrate plant No. 2 at Muscle Shoals for the manufacture and distribution of fertilizer by the Department of Agriculture and the sale of surplus power by the War Department. Military Affairs.

Power Projects

H. R. 15213. This bill authorizes the Interior Department to develop and lease power on Indian irrigation projects. Reported by Indian Committee.

H. R. 5773. This law authorizes an appropriation of $165,000,000 for flood control, irrigation and power development on the Colorado River. A power dam is authorized to be constructed at Black or Boulder Canyon. A board of geologists and engineers has recommended the former site. The project will not be started until the development plan is approved by Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming. The Government has the option of building the power plant and leasing it to private interests or of authorizing its construction by private parties. Before the plant is constructed the Interior Department must be assured of adequate revenues from it to repay its cost in 50 years. The Interior Department will award contracts for the sale and delivery of power for not more than 50-year periods. Enacted into law.

H. Con. Res. 47, Mr. Davis (Dem., Tenn.); S. Con. Res. 29, Mr. Dill (Dem., Wash.). These resolutions propose to refer to the Department of Justice charges of monopoly in the manufacture of radio apparatus by the General Electric Company, Western Electric Company and the Westinghouse Electric Company and others. Interstate Commerce.

S. 5029. Mr. Fess (Rep., Ohio.). This bill authorizes consolidations of railroads. Interstate Commerce.

GOVERNMENT CONTRACTS

H. R. 15713. Mr. Cramton (Rep., Mich.). This bill describes uniform requirements for Government contracts. It provides that in purchasing fuel the Navy Department shall have power to discriminate as to the kind of fuel best adapted for naval uses. Contractors shall observe the eight-hour day in fulfilling Government contracts. Preference shall be given domestic commodities in making Government purchases. Judiciary.

S. J. Res. 186. Mr. King (Dem., Utah). This resolution authorizes the President to appoint three persons to investigate the need for additional inter-oceanic canal facilities. An appropriation of $50,000 is provided.

H. R. 7729. This bill would forbid the shipment in interstate commerce of goods manufactured, produced or mined by convict labor. The act will not take effect until five years after its approval. The bill has been passed by the House and Senate and is before the President for action.

S. 5242. Mr. Smoot (Rep., Utah). This bill would authorize the continuance in the Government service of employes engaged in special research after they reach the retirement age. Civil Service.

S. 5203. Mr. Brookhart (Rep., Iowa). This bill would establish an eight-hour day for private employes in the District of Columbia. District of Columbia.

H. R. 15969. Mr. Free (Rep., Calif.). This bill would permit the entry of aliens for employment in American companies in mechanical, electrical or chemical processes in cases where persons of similar qualifications can not be found in the United States. Immigration.

S. J. Res. 192. Mr. Nye (Rep., N. Dak.). This resolution continues until June 30, 1930, the present method of determining immigration quotas. Immigration.

H. J. Res. 364. Mr. Hall (Rep., Ill.). This resolution proposes a constitutional amendment to make ex-Presidents members of the Senate for life. Judiciary.

H. R. 12695. This bill authorizes the licensing of patents owned by the Government. Reported by the Senate Patents Committee.

IMPORTANT BILLS REVIEWED IN THIS ISSUE

Mining

H. R. 15919—Douglas (D., Ariz.). Mineral Patents at Depth. Public Lands.
H. R. 15861—Vinson (D., Ga.). War Mineral Appeals. Mines and Mining.
S. 5348—Norbeck (R., S. Dak.). Mining Claims. Public Lands.
S. 3776—Enacted Into Law. Land Patents.
H. R. 10157—Passed by Senate. Mineral School Grant.
H. R. 15732—Reported by Committee. Miners Hospital Land Grant.

Revenue

H. R. 15654—Manlove (R., Mo.). Tariff Commission.
S. 5154—Norris (R., Nebr.). New Claims Court. Judiciary.
S. 5319—Reported by Committee. Tax Refund Review.

Power

H. R. 15575—Hull (D., Tenn.). Water Power Policy.
S. 5218—McKellar (D., Tenn.). Muscle Shoals Power.
H. J. Res. 370—Crisp (D., Ga.). Muscle Shoals Project.
H. R. 15213—Reported by Committee. Indian Power Leases.
H. R. 5773—Enacted Into Law. Colorado River Development.

Miscellaneous

H. R. 15713—Crampton (R., Mich.). Government Contracts.
S. J. Res. 186—King (D., Utah). Ocean Canals.
H. R. 7729—Passed by Senate. Convict Labor.
H. R. 12695—Reported by Committee. License Government Patents.

COAL-WASHING EXPERIMENTS IN ALABAMA

A study of the coal-washing problems of Alabama is being conducted by the United States Bureau of Mines in cooperation with the University of Alabama. The work, which is just getting under way at the southern experiment station of the Bureau of Mines, Tuscaloosa, Ala., includes a detailed examination of each of the important coal seams of the state by float-and-sink and screen-sizing tests and studies of the systems of coal preparation now in use both to determine their effectiveness and to develop better methods where the results now obtained are unsatisfactory.

The first step in the study of each seam is to obtain representative samples. This involves in some instances the taking of several samples at different washeries to get representative samples of each area of the seam. Each sample is usually taken ahead of the feed bin to the washers. It includes only the portion washed. If the lump is crushed it is included, but if it is hand sorted and sold separately it is not included. The sample is taken at uniform intervals over several days time and totals three to five tons. At the laboratory this sample is screened into four or five sizes, each of which is separated by float-and-sink tests in solutions of specific gravities varying from 1.20 to 2.20. Because shape as well as size and specific gravity is an important factor in coal washing, a number of the heavier float-and-sink fractions are separated on slotted screens to determine the proportion of flat particles present.

In this work the following committee of prominent coal operators is advising the Bureau of Mines engineers in regard to important phases of the work:

M. W. Bush, president, Alabama By-Products Corporation.

C. E. Bowron, chief engineer, Gulf States Steel Company.

Chas. F. DeBardeleben, president, Alabama Fuel and Iron Company.

B. F. Roden, president, Roden Coal Company.

Milton H. Fiess, vice president, DeBardeleben Coal Corporation.

F. G. Morris, general superintendent of coal mines, Republic Steel and Iron Company.

H. J. Thomas, general superintendent of mines, Sloss-Sheffield Steel and Iron Company.

C. E. Abbott, general manager of mines, Tennessee Coal, Iron and Railroad Company.

J. A. Long, general manager, Woodward Iron Company.

Ex-officio members of the committee are as follows:

Jas. L. Davidson, secretary, Alabama Mining Institute.

H. E. Mills, assistant secretary, Alabama Mining Institute.

J. R. Cudworth, acting director, School of Mines, University of Alabama.

CARBON MONOXIDE FILM SHOWN EXTENSIVELY IN CANADA

The Province of Quebec Safety League, which has been instrumental in the exhibition in Canada of the motion picture film "Carbon Monoxide—the Unseen Danger," recently completed by the Department of Commerce through the United States Bureau of Mines, has informed the bureau that the Theater Owners Association of Quebec has undertaken to run the film for a week at each of its houses. As there are 147 theaters in the association, the Province of Quebec Safety League has inquired regarding the purchase of additional copies of the film.

MECHANIZING *the* COAL MINES

By DAVID INGLE *

Mechanization Has Been Slowly But Steadily Progressing For An Amazing Length Of Time—Real Impetus Given Shortly After The War When Coal Producers Were Faced With Keen Competition—Attitude of Workers — More Recent Developments —Possibilities

WE have been adopting mechanization on a slowly accelerating scale ever since the installation of the first crude steam pumps in the English coal mines, back in the eighteenth century. Perhaps these happenings, some 150 years ago, might be taken to mark the first use of other than muscular effort in a coal mine.

The advance was very slow. First steam pumps, then, quite a while later, primitive steam hoisting engines. Years later still the first use of compressed air instead of steam for the same purposes of pumping and hoisting, but an advance over steam because compressed air could be carried much farther in pipes without losing its efficacy.

Until perhaps 40 years ago, steam and compressed air were still the only prime movers used in the mines. During the interval prior to that time steam haulage and compressed air locomotives had been tried and gradually developed until they were fairly common.

Then, 40 years ago, things began to happen. Compressed air machines were built for the undercutting and shearing of the coal. Somebody had a happy thought and tried to improve the screening of coal by building a movable screen that could be jerked back and forth by a steam piston. It worked, and the idea spread rapidly. Incidentally right there began the troubles of the coal salesman. He may have thought he had a hard life before, but he did not. His troubles began with the multiplicity of sizes that the shaker screen brought forth, with one size of coal in big demand, and three others that nobody cared for.

Just about this same time, 40 years ago, other persons of an inventive turn began to use electric trucks to haul coal cars in the mine. That seemed to work so well that they hitched a motor to a contraption for undercutting the coal. That worked, too, after a few hitches, and then the progress became rapid. In that decade, the decade of the "gay nineties," mechanization, as applied to coal mines, was really born.

Just previous to that same period was born the United Mine Workers organization, and during the period the union spread rapidly through the coal fields, so that by the end of the decade it practically covered the great producing coal fields of the country. The union was an economic development, just as much as was the increased use of machinery in the mines, and it was probably just as necessary. I am not going to argue that point.

Perhaps the union really did a great deal to stabilize the industry in its early decades. But with its growth in popularity with the coal mine workers grew power; power to say what its members should do, as workers in the industry, and likewise power to say what they would not do.

Now, the average American miner is the son of a coal miner, maybe the grandson of one. In the old days, in England, the majority of the underground workers were coal hewers; they used the pick as well as the shovel, and with the pick they cut narrow grooves deep into and under the coal seam in order that the coal might be free to break out with less powder, if indeed they used explosives at all. They did this primarily to save powder, which cost money, but more especially to get the coal loose for loading in as large pieces as possible. Then, as now, large coal brought a much better price in the market than small coal. So important was this business of the size of the coal that mine owners regarded the small coal as worthless, and they constructed screens made of narrow bars of specified width, and spaced a specified distance apart. All the coal produced was slid over these screens, and the miners were paid only for the coal that passed over the screens.

Hence the desire to prepare the coal in as large pieces as possible. This being the case, the miner who made the best and most frequent use of his pick earned the greatest amount of money. And because he was paid for his labor in this way, by the ton, he gradually took unto himself a certain independence. If he loafed on the job it was his loss, not the mine owner's. At least he was honest in feeling that way about it. He was working for himself, not for the company. As he was working for himself, he was not much in the habit of being ordered about by the pit boss.

This had been a long established condition when the rapid spread of unionism engulfed the coal fields of the country.

Because the great majority of the underground workers were paid by the ton, they dominated the union. The underground men who did not prepare and load the coal, such as the timber men, the pumpers, the track men, the coal haulers, were paid by the day for their time. In preunion days these day men worked from starting time until quitting time pretty much under the surveillance of the pit boss or his assistants. When the union came the preponderance of tonnage men over day men, with the old independence of the tonnage men, caused a tendency to more independence on the part of the day men, and any defiance of authority by a day man was quick to receive the backing of the local union. This gradually led to less and less control of the employes by the company, and to more and more control by the union, until in many mines the company had mighty little to say about how its own property should be operated.

This condition of dictation by the union and its officials reached its peak during the World War, when coal production and demand reached a level not since equalled, and when the necessity for continuous production of coal for war purposes, almost regardless of consequences, resulted in concessions by the mine owners of almost every demand made by the union officials, backed up as they were by the absolute power to stop production at any mine instantly by calling a strike of the workers if their demands were not immediately complied with.

Under such a situation the coal miner

* Evansville, Indiana.

soon acquired an inflated idea of his right to say what kind of work he should do or should not do. His father had been a coal miner, paid by the ton, who worked when he pleased and quit when he got ready. He inherited the idea, and in the war time of high pressure for coal under any circumstances, he went his father one better and not only dictated when he would work and when he would not, but also he decided how he should work and what he should do.

Such a condition of affairs naturally added item after item to labor costs of coal production. It resulted in the forcing of many additional men into the mine to do jobs that required only a small part of the time to do, jobs that the miner had always done but which he decided in future should be done for him.

The cost of producing coal under union domination increased enormously.

The result was that new mines were opened outside of the old union territory. These new mines employed mountaineers, colored men, foreigners, men who were glad to get work at a fraction of the scale demanded by the union. Also, these mines were newly opened, and many of them with modern equipment.

After the war, when the inevitable slump in demand for coal came with the cessation of war activities, these new mines, with their low labor costs, their new equipment, their close coal, were easily able to hold to their business and to make heavy inroads in the business always held by the older union mines. By the spring of 1922 thousands of formerly prosperous union mines were practically bankrupt, for inability to compete.

Having no other alternative, some of these union mine owners decided to turn to a program of increased mechanization. If they could not get away from prohibitively high wages they would install machinery that would at least result in the production of more coal per man, and thus decrease their pay-roll costs. And thus was given, in 1922, a forced impetus to mechanization.

This was somewhat slow in starting because the union miner did not care to be displaced by a machine, and was not going to allow it to happen. But there were in existence many mines that had been idle most of the time since the war. The employes of these mines were out of work, some of them were hungry and anxious to work. In some of such mines union workers were glad to start working with machines in order to get work at all, and thus was the chance to install loading machines in union mines brought about.

Very soon the men came to find that operating a coal loading machine was much easier work than shoveling coal all day long. They also discovered that mines using loading machines were operating more days, as a rule, than mines not using such equipment, and that consequently they were getting steadier employment and fuller pay envelopes. So in the machine mines opposition to the machines on the part of the employes subsided very promptly. The opposition then and now comes from outside, from the men who have not the chance to work with the machines and who fear that the machine mines will put their mines out of business.

There was resistance, and is still, in mines just starting the use of machines. When it was not active it was passive resistance, taking the form of holding back, limiting the amount of coal loaded, tampering with the machines themselves. This, in the experience of the writer, was not done with the knowledge or connivance of the highest officials of the union. And when it was brought to their attention it usually ceased pretty promptly.

Since 1922, the attitude of labor has changed quite a bit. In the mines where coal is loaded entirely by machines there is no opposition to the machines, generally speaking; the workers are just as enthusiastic about the machines as are the employers.

The worker finds that instead of working in a solitary place performing plain, back-breaking drudgery, shoveling coal all day, as he did if he was ambitious, in the traditional coal mine, he now is one of a crew of some 10 to 20 men with the coal loading machine, the undercutting machine, the coal drilling machine, and the gathering locomotive, as his implements of work. This crew of men are working in comfort and in close touch with each other, in a well-lighted, well-ventilated, carefully inspected section of the mine. Each man is a cog in the complete unit. On his individual head, as much as on any of the others, rests the harmonious operation of the whole crew.

It was shortly after 1922 that the American Mining Congress held its first machinery exhibit and "Experience Meeting" in Cincinnati. All coal operating men, engineers, machinery builders and others interested were invited. Everybody who attended came home glad he went. Every year since then a similar meeting has been held under the auspices of the Mining Congress at Cincinnati, in May. Every meeting has been better than the previous one. The cooperation of machinery makers, salesmen, mine operatives, and public speakers of talent has resulted in a permanent institution, and one that perhaps, more than any other one thing, has helped to advance the mechanization of coal mines. We in Indiana have learned just what the boys are doing in Wyoming and in West Virginia, and they in their turn have had opportunity to check up on us and learn if, perchance, we have developed any new wrinkle that might be of benefit to them.

The Mining Congress meetings have done this for us. Now, we are assured of a new plan by the Mining Congress which supplements and carries one step further the Cincinnati meeting idea, to further spread and inculcate the gospel of mechanization. The new mechanization committee recently started has for its object a five-year program for the purpose of promoting safety, economy, and efficiency in the mining industry.

The main committee has appointed smaller committees, whose members are located geographically all over the coal fields, and other smaller committees whose members are to deal with particular branches of mechanization. All committees are to report matters of interest to the general committee, whose business it will be to correlate and publish matters of interest and information.

Mine mechanization, we must feel, is in its infancy. But it is a husky infant. With the Mining Congress doing so much to encourage cooperation we may make some tremendous advances in the allotted five years.

FOREIGN MINING TAXES and DOUBLE TAXATION

(*From page* 116)

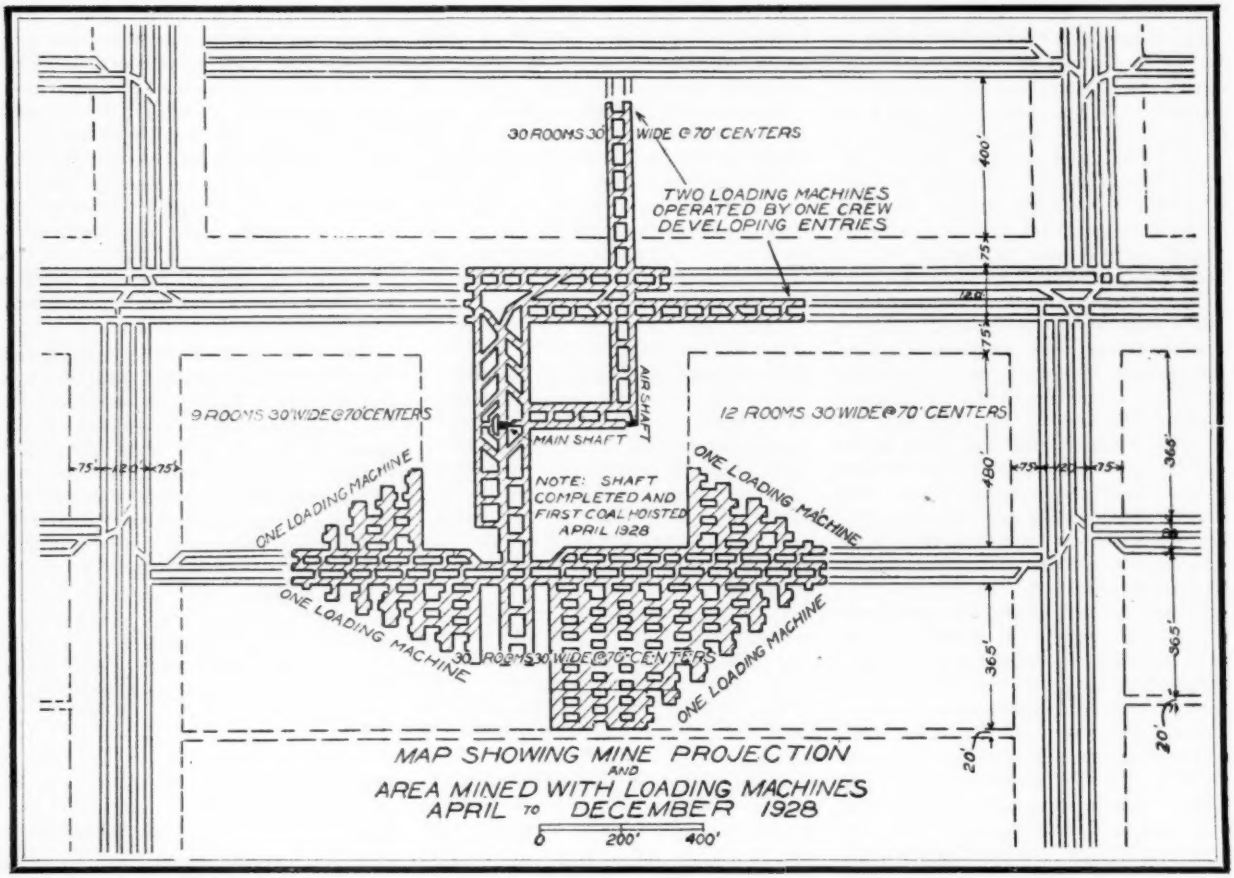
(Revenue Act of 1918 to 1926 sections 222 and 238; Act of 1928, section 131.) The same credit is given resident aliens on condition of reciprocity.

In substance, this credit amounts to either the foreign tax paid or the American tax on the foreign income, whichever is the lesser. If the foreign tax exceeds the credit, the excess is deductible in computing net income. (Act of 1928, section 23 (c).)

The principle of reciprocal exemption of shipping profits, introduced by the Act of 1921 (to Act of 1926, section 213 (b) (8); Act of 1928, section 212 (b) and 231 (b)) has been adopted by practically all the important commercial countries.

Under this credit system America, the country of residence, gives up its tax in favor of the countries of origin, at the expense of Federal revenues. Under some of the treaties between European states and under the Geneva conventions, the state of origin forces its tax on certain items of income in favor of the country of residence.

The benefits to be gained under such arrangements are obvious. If Americans were exempted from tax abroad on certain kinds of income they would then pay tax only in the United States, and the United States Treasury would collect its full tax.



MECHANIZATION REPORT NO. 92

By G. B. SOUTHWARD

MECHANICAL LOADERS IN ENTRIES AND ROOMS

Supplementing Report No. 29.

MECHANIZATION Report No. 92 describes a mine which is worked entirely with mechanical loaders in a seam of coal about 7 feet high, and shows the advancement and progress made since their operation was described in our Mechanization Report No. 29, published in the July, 1927, issue of THE MINING CONGRESS JOURNAL. The first report was based on the data and information taken during the month of February, 1927, and showed the mining system, the method of operation and the number of men employed for the mechanical loading as of that date. The development which had been made at that time was the result of about one year's actual operation with the loading machines.

The mine in which the machines were then used had originally been worked by hand loading in the room and pillar system. When the loading machines were installed the room and pillar system was continued, but the plan was modified to a considerable extent so as to provide a more concentrated and a more systematic method of working than had been required for the hand loading. This system, as briefly described in report No. 29, is still being used and is shown in more detail later in this report.

The first operation was carried on under a number of rather severe handicaps. The mine cars were of small capacity as designed for hand loading. The workings as developed by hand loading were scattered over a rather large territory and could not well be concentrated. The haulage system and the general underground operation and facilities were not suitably arranged for mechanized loading. In spite of these handicaps, the management succeeded in demonstrating to their own satisfaction that mechanized loading was more efficient and more economical than hand work. However, it was equally demonstrated that in order to take the fullest advantage of mechanical loading and to realize the greater degree of efficiency and profit that mechanized loading offered over hand work, the underground arrangement should be redesigned to suit the requirements of a mechanical operation. The conditions existing in the old mine were such that the management decided to sink a new shaft and develop an entirely new operation, and in the summer of 1927 the work in the old mine was stopped, the machines and equipment were removed, and the workings abandoned.

In August, 1927, the company started building a new plant. The construction work proceeded rapidly, and during February, 1928, the shaft sinking was completed, and in the month of April the first coal was hoisted. All entry development from the shaft bottom was done with loading machines working on single shift, and in four months time—by August, 1928—the production had reached approximately 20,000 tons per month. The tonnage during the first three months was mined entirely from entries, but in

August some rooms were started. At the present time there are five loading machine units in operation; one of these is working entirely on entry development, while the other four are working in advancing room panels and an average production of approximately 1,000 tons per day is being mined. The location of the present machines and the mine development which has been made during the seven months operating period—from April to December, 1928—is shown on the accompanying map in Figure 1.

Improvements Over Old Operation

A comparison between the present operation and that described in Report No. 91 shows that there have been quite a number of improvements effected. The mining plan as well as the underground facilities have been designed to suit the requirements of mechanization. New mine cars have been installed which have a capacity of 4 tons, as compared to a capacity of 1¾ tons in the old operation. The increased size of the new type has proved a decided factor in increasing the tonnage of the machines. The mining system shown in detail in Figures 2 and 3 is the same as used in the original operation except that the room widths have been increased from 20 to 30 ft. The concentrated working territory and the short haul is a marked advantage over the long haul and scattered workings in the old mine. As the workings advance the present concentration in the room panels will remain constant, but the main line haulage distance will be increased. In time this may require some additional haulage equipment in the way of locomotives and mine cars over that now used, but this increase should never become a serious item in the total mining or equipment cost.

In the old mine the average tonnage per machine was from 100 to 125 tons per shift and a total of nine loading machines were used to produce an average tonnage of approximately 1,000 tons per day. In the present mine, as shown later in this report, the daily tonnage is now averaging approximately 1,000 tons per day, and this is being produced by five loading machine operations. In other words, the new mine is now producing with five machines a daily tonnage equal to that which formerly required nine machines. In the old operation, a crew of nine men were used on each loading crew and the nine machines, therefore, required a total of 81 men for the regular daily shift. The present operation uses 10 men on each loading machine and the five machines employ a total crew of 50 men. Comparing these two figures shows that the former production of approximately 12 tons per man on the loading machine crews has now been increased to 20 tons per man. Neither of these figures take into account the men employed underground for main line haulage and general mine maintenance or for tipple and other surface labor.

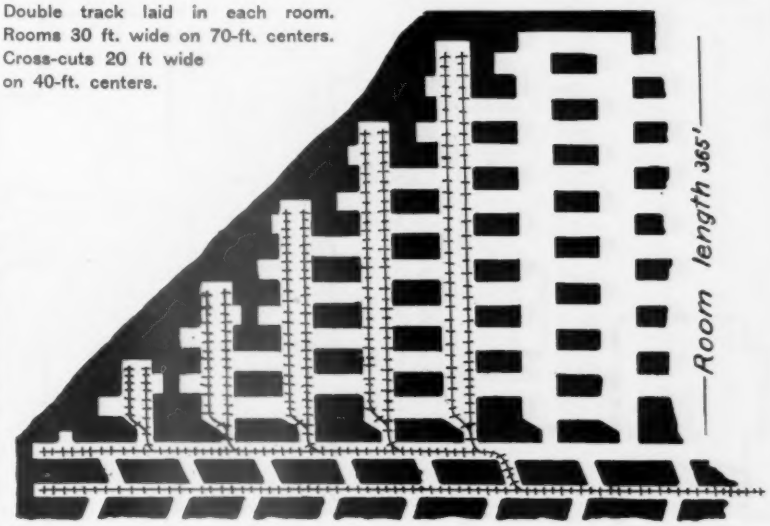


Figure 2
Sketch showing plan of rooms and breakthroughs as mined with loading machines.

Production Records

The first coal from the new shaft was hoisted during the month of April, 1928, and the production during the succeeding six months is given below:

	Tons
May, 1928	7,154
June, 1928	9,950
July, 1928	14,544
August, 1928	19,704
September, 1928	19,830
October, 1928	23,701
November, 1928	25,112*
December, 1928	25,315*

* Twenty-four days worked.

These tonnages were mined entirely with loading machines, as there has been no hand loading done at this new operation. With the exception of the one unit which is now working on night shift (as previously explained in this report), all this entry work has been done on a single shift of eight hours. The speed at which the entries have been driven with the machines—combined with the concentrated mining system—has greatly reduced the length of the development period which would have been required for bringing this mine up to its present production with hand loading. Without counting the direct savings made in the actual loading and mine operating costs, the indirect savings effected by this rapid rate of development constitutes one of the very material advantages of a mechanized mine.

The actual cost figures which are now being made are confidential and can not be published. However, the fact that this company, after experimenting and operating with mechanical loaders, has gone to the expense of constructing a new plant and developing a new mine to be worked entirely with mechanized loading is sufficient evidence that mechanization has proved practicable and economical. The further fact that this mine has operated at approximately full time since it was opened is further evidence of the ability of mechanized mining to operate successfully in the present competitive coal market.

OPERATING REPORT

The seam averages about 7 ft. in height of fairly hard coal with no regular band of impurities. The top is a slate which stands well with light timbering. The bottom is medium hard fire clay; seam is fairly level; cover about 200 ft.; open lights are used.

The mining system is a room and pillar method which has been modified from the hand system so as to provide a systematic concentration of working places. The general arrangement of the panel is shown in Figure 2 and a more detailed plan is shown in Figure 3. The distinguishing feature of this design is that two working places for the loading machine are always available in each room—one at the room face and one in a crosscut. The crosscuts are driven to the right and left off each room and advance half way through the pillar, where they are met by similar breakthroughs driven from the adjoining room. Two tracks

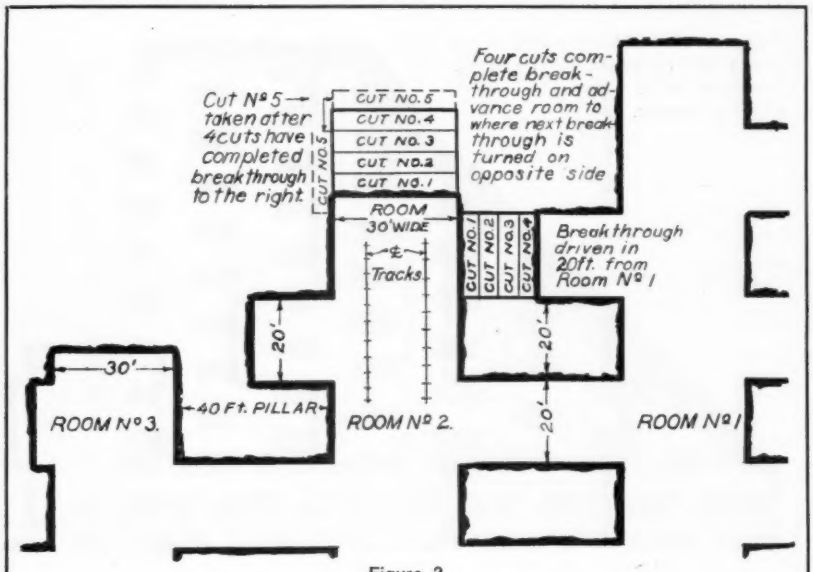


Figure 3

Sketch showing detail of cutting in rooms and breakthroughs for mechanical loading.

are laid in each room and the thickness of the pillar is such that the loading machine can mine half way through a cross-cut and load into a car placed on the room track without laying turns or switches. The breakthroughs are so spaced that as soon as one has been driven its required distance the next one ahead is ready to be turned. This does not involve any complicated cutting schedule—it simply requires that the loading must alternate between the room face and a breakthrough. The advantages of this arrangement in providing a highly concentrated working territory is well illustrated on the map in Figure 1, where a total of 22 rooms and 10 entries produce an output of 1,000 tons per day.

A unit operation consists of cutting, drilling, loading, gathering and track work, and each unit has one loading machine, one cutting machine, one gathering locomotive and one electric hand drill. Each operating crew consists of 10 men; 1 foreman, 2 cutting machine men, 2 drill operators who also load and fire the shots, 2 on the loading machine, 2 on the gathering locomotive and 1 track and timberman. All work in a unit is carried on during a single shift, and each machine has a sufficient number of working places in its territory so that these operations can all be performed simultaneously and continuously during the working shift without interfering with each other. The loading machines are a mobile type equipped with caterpillar trucks. These are set at track gauge so that the machine can travel on the mine tracks when moving from one working place to another. When loading at the face, the machine sets on the pavement.

As shown in Figure 1, a set of three entries develops a double panel with rooms driven to the right and left. Two loading machines are used in one of these double panels—each machine working the rooms on one side of the panel only. The entries are driven by either of these two machines and are only advanced at a sufficient rate to provide a new room neck as soon as one of the working rooms is driven up and completed. As shown in Figures 1 and 2, when a panel is in full development six rooms are working. Including the entries, this provides from 12 to 14 working places in the territory. An average of six cuts is usually cleaned up during each working shift by the machine loading crew, and these cuts are about evenly divided between the room faces and the breakthroughs. Each room cut will produce about 40 tons of coal and each breakthrough about 30 tons. As shown in the tonnage figures already given in this report, five machine operations are now averaging approximately 1,000 tons per day. Four of these are in room work and one operation is confined to entry development. In the room work the machines will usually average slightly over 200 tons per shift and in the entry development the average will be somewhat under 200 tons.

At the present time one loading machine is working entirely on entry development driving two main entries, and two cross entries as shown on the map in Figure 1. On account of having extra loading machines on hand which are not yet needed for other working places, two machines are used for driving these four entries. One machine is used to drive each pair and one crew operates both machines, and an average of from seven to nine entry cuts is usually loaded out during the shift. At times these cuts are distributed between the four entries and their breakthroughs making an average advance of from one and a half to two cuts per day in each heading. At other times the entire shift is concentrated into one pair of entries, and in such cases a daily average of three cuts is usually made in each heading. Since the depth of the cut is about 5½ ft., this means that entries are advanced a distance of 15 ft. during each working shift. A regular crew of 10 men is employed for the machine operation in the entry development, and the methods of working are the same as in the room panels except that a blower and tubing is used to ventilate the working face in the entries.

The machine loads directly into mine cars which are placed by a gathering locomotive. When loading a room face, one car is placed at a time but when working in a break-through, it is usually possible to place two or more cars for loading. The mine cars which are used in the new operation were designed for loading by machine. These are of steel construction and have a capacity of 4 tons, as compared to 1¾ ton capacity for the hand loading type. The cars are built 6 ft. wide and about 12 ft. long. The increased width has been found to be a decided advantage in "spotting" the boom of the loading machine, and the length is such that when the car is bumpered against the loading machine the boom will discharge into the front end.

At present there are only 50 cars at this mine; 30 additional cars are on order for delivery within the next month. Because of the mine car shortage it is not possible to operate all five of the loading machines on one shift, and one machine is working at night. Approximately 800 tons are being loaded by the four operations on the day shift with 50 mine cars, and this means that each car is making four round trips per shift.

As shown on the map in Figure 2, the room work and the breakthroughs mine about 70 percent of the solid coal. After the room is driven up the top pillars are recovered—the recovery usually proceeds down the room until the roof fall occurs. After the fall no further pillar recovery is done in that room. There are at present no figures available to show what percentage of the total area is mined, but the pillar recovery does not attempt to mine any great amount of coal.

All coal is machine undercut to a depth of 5½ ft., drilled with an electric hand drill and shot with permissible explosive. The tipple is equipped with shaking screens and picking tables. Some additional picking labor is required over that used for hand mining, but the coal sizes are reported by the management to compare favorably to those formerly produced with hand loading.

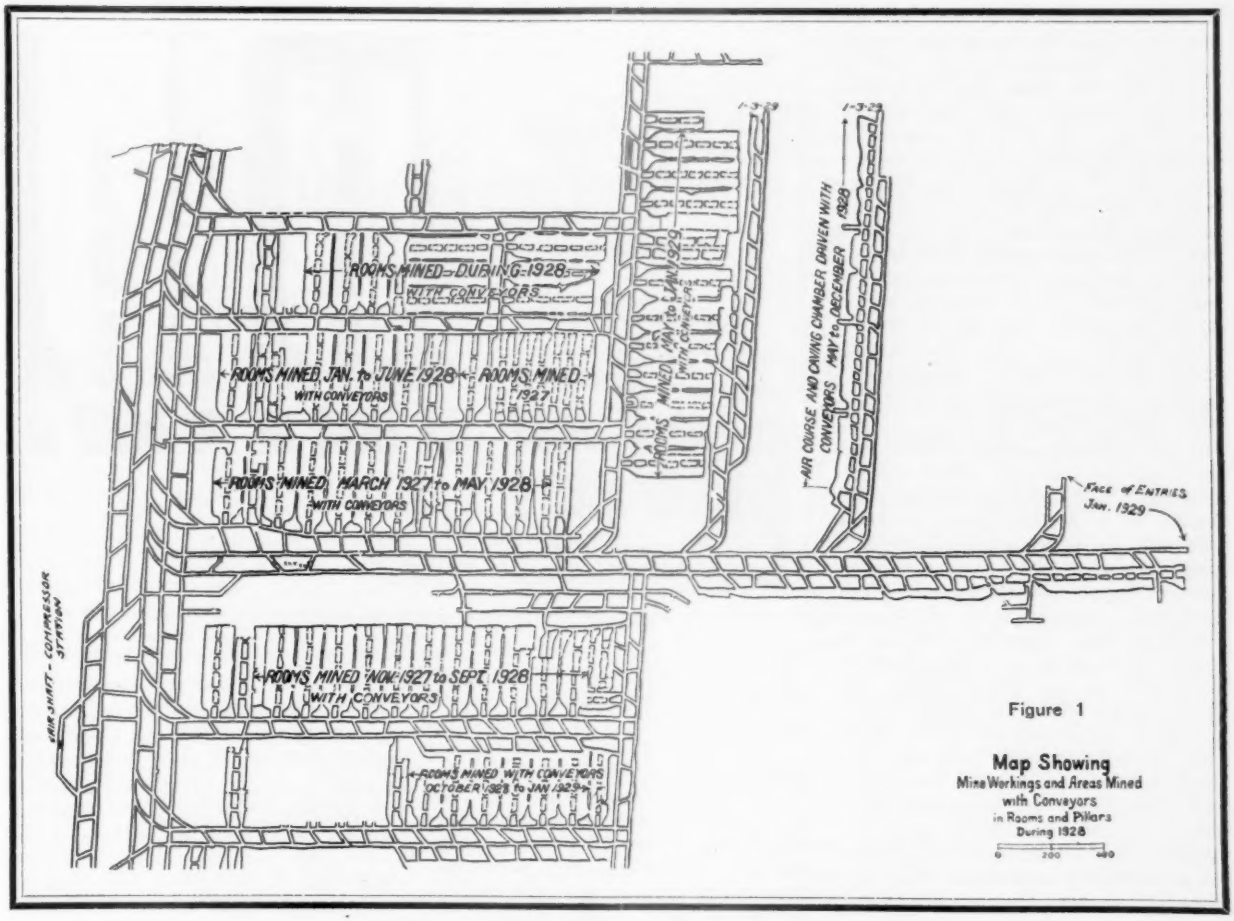


Figure 1

MECHANIZATION REPORT NO. 93

By G. B. SOUTHWARD

CONVEYOR MINING IN ENTRIES, ROOMS AND PILLARS

Supplementing Report No. 418.

MECHANIZATION Report No. 93 describes a conveyor mining operation working the room and pillar system in a fairly level seam of coal about 4 ft. high, and shows the mining methods and practices now in effect which have been developed during a two and one-half year period. Mechanization Report No. 418, which was published in the August, 1927, issue of THE MINING CONGRESS JOURNAL, described the conveyor operation at this same mine as in effect in April, 1927, and the following account is here submitted to show the progress which has been made since the earlier report was written.

In April, 1927, the one unit described in Report No. 418 was the only conveyor installation operated by this company. This proved successful, and since that time 12 additional conveyor units have been installed on this same system in several mines. Four of these units are located in a section of one mine, and since these four are generally typical of the other installations they will be described in this report as representing the conveyor mining practices as developed by this company. The map in Figure 1 shows this section of the mine and the territory worked with conveyors during the year 1928.

The mining system followed in 1927 has not been changed, and as described in Report No. 418, two rooms are worked together as one operating unit. In advancing a pair of rooms, a haulage conveyor is laid along the rib of one room extending from the entry to the room face and is lengthened each day as the room advances. A light portable conveyor is laid along the face of the room onto which the coal is hand shoveled; this face conveyor discharges onto the haulage conveyor. In the adjoining room the face conveyor discharges onto a short haulage conveyor which extends down that room to the last crosscut, through which another light conveyor transports the coal to the haulage conveyor in the next room. When the pillars are being recovered both face conveyors are removed and the pillars are mined by slab cuts about 30 ft. long parallel to the room length, and this coal is loaded onto the haulage conveyors. Figure 2 shows the general mining plan and the arrangement of the conveyors for the room advancement and pillar recovery.

CAVING CHAMBERS

One of the most interesting features at this mine has been the development of a method for eliminating roof trouble in the entries and rooms. The mine has operated for a number of years, and in certain sections of the workings the roof has been difficult to support, requiring

heavy timbers and cross bars, but some time ago it was discovered that an entry or a room which was driven close to an area which had been mined and caved was not troubled with bad top. The management, therefore, took advantage of this condition and found that by driving a room of sufficient width to get a comparatively high roof fall parallel to and in advance of an entry, the top in the entry would be sound and would stand without timbering. The method of driving these rooms or "caving chambers" will be described later in this report.

Several theories have been advanced to explain this condition. One is that a small coal seam which occurs a short distance above the mining seam contains gas with sufficient pressure to break down the roof, and that after a fall this gas pressure is relieved over a limited adjoining area. Another theory is that a strata of soapstone above the seam is under pressure due to contained moisture and that a roof fall will relieve this pressure. A third theory is that the roof strata is under internal stress due to flexture or bending, and that a break in the top relieves this. No explanation has as yet been proven, but it may be accepted as a fact that the caving chambers have undoubtedly reduced roof troubles at this mine. This method has now been carried on for several years and has proved successful in a sufficient number of entries and rooms to eliminate the possibility of coincidence.

A very convincing example of the effect of roof caves at this mine is shown in the room work in Figure 3. In this panel the rooms were worked retreating and rooms 23 and 24 were started at the top of the entry driving in the solid coal. When they had advanced a distance of 175 ft. the top could no longer be held, and both rooms were abandoned and caved. Rooms 21 and 22 were then started and encountered no roof trouble until they had passed the face of Nos. 23 and 24, but when they had advanced about 50 ft. beyond this point the roof weight became so heavy that these rooms were also abandoned and caved. The same experience was repeated in Nos. 19 and 20, but by the use of an excessive amount of timbering these two rooms were driven through to their required distance of 360 ft. From this point on the remaining rooms were advanced on the regular schedule without interruption, and no caves occurred until the pillars were drawn out and the rooms completed. This map gives the dates showing the progress of the room work and pillar recovery, and also the dates on which the roof caves occurred.

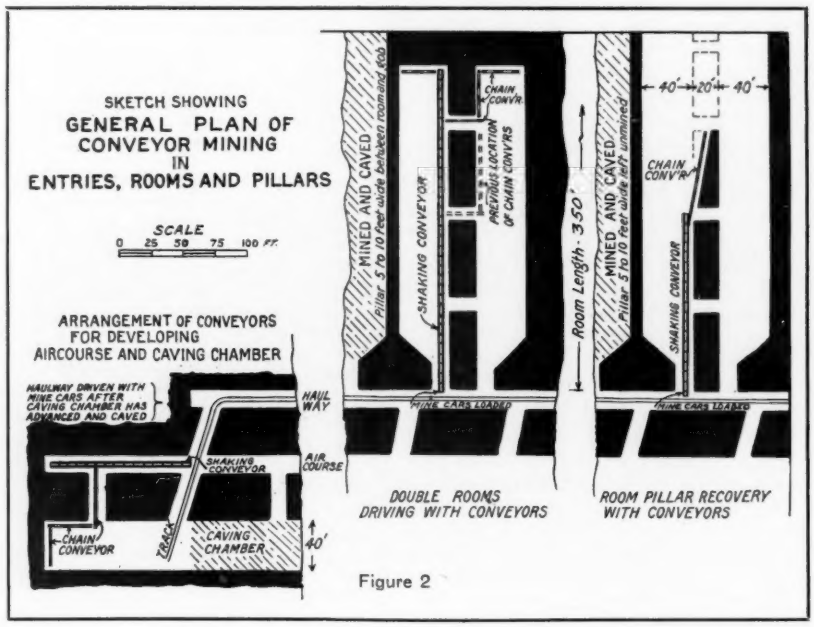


Figure 2

Changes and Improvements Since 1927

The caving chamber principle is now a part of the regular mining system and is used in both entry and room work. In the operation described in Report No. 418 the panel was developed by a pair of entries which served as a haulageway and air course, and both of these entries were driven by hand loading into mine cars. The present development plan for a panel now has a haulageway, which is driven about 14 ft. wide, an air course from 18 to 20 ft. wide, and a "caving chamber" which is driven from 30 to 40 ft. wide. The haulageway is still driven by hand loading, but the air course and caving chamber are mined with conveyor loading; these are kept advancing ahead of the haulageway, so that the cave will

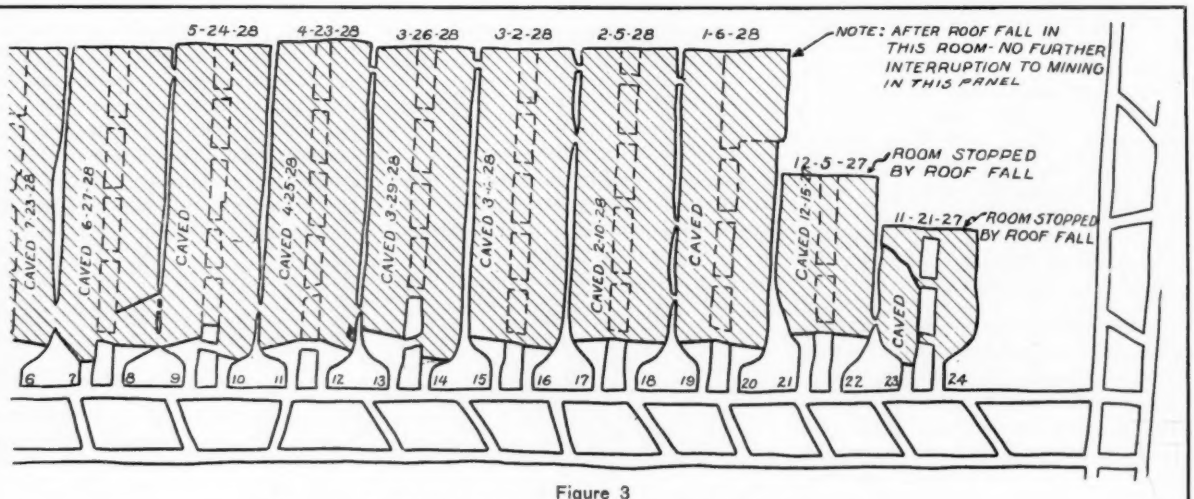


Figure 3
Upper end of panel with rooms and pillars mined with conveyors, showing high coal recovery and rapid rate of mining after first complete roof fall occurs.

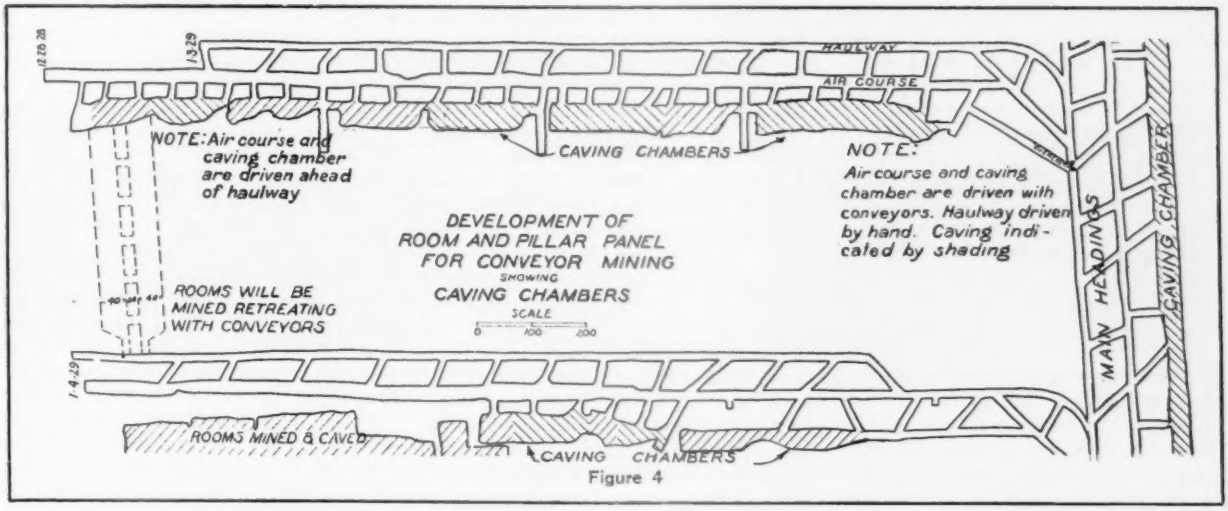


Figure 4

occur before the haulageway is driven. About 2½ ft. of bottom rock is taken along the haulageway, but no top or bottom is taken in the air course or room.

The arrangement of the conveyors in driving the air course and caving chamber is shown in Figure 2 and the entry development for a room panel is shown in Figure 4. In the latter figure it will be noticed that in the first set of entries the caving chamber is only driven as far as the mined area made by the room work in the panel below. From this point on the air course and haulageway get the favorable roof effect caused by the caves in the room panel. The second set of entries is a typical example of entry driving in a solid coal area.

In the operation described in Report No. 418 the rooms were worked advancing, but this has been changed and all rooms are now worked on the retreating system. Figure 5 illustrates the manner in which the caving principle is employed in starting the room work. The pair of top line rooms—marked Nos. 29 and 30—are driven narrow as part of the panel development and the pillar between these rooms is mined out by slabbing so as to provide a sufficient area for a roof cave before the conveyor mining in the room below is begun. The advantages of this can be seen by comparing this panel with that shown in Figure 3, where the difficulty of maintaining the top before a cave occurred has already been described in a preceding paragraph of this report.

The conveyors and the drills are operated by compressed air, and in the first installation a small portable compressor was used underground. The other three conveyor units which have since been added are concentrated in one section of the mine, and a permanent air compressor plant has been installed on the surface near the top of an air shaft, as indicated on the map in Figure 1. The total distance from the top of the shaft to the conveyor workings is about 1 mile, and a 4-in. pipe line is laid from the compressor station to the point where the 3-in. branch lines are taken off to the various conveyor panels. The compressor is driven by an electric motor operating at 2,300 volts a. c. There is, of course, a direct power loss in converting electric power into compressed air, but the greater efficiency of the high voltage at the compressor motors, as compared to the conversion loss and line drop

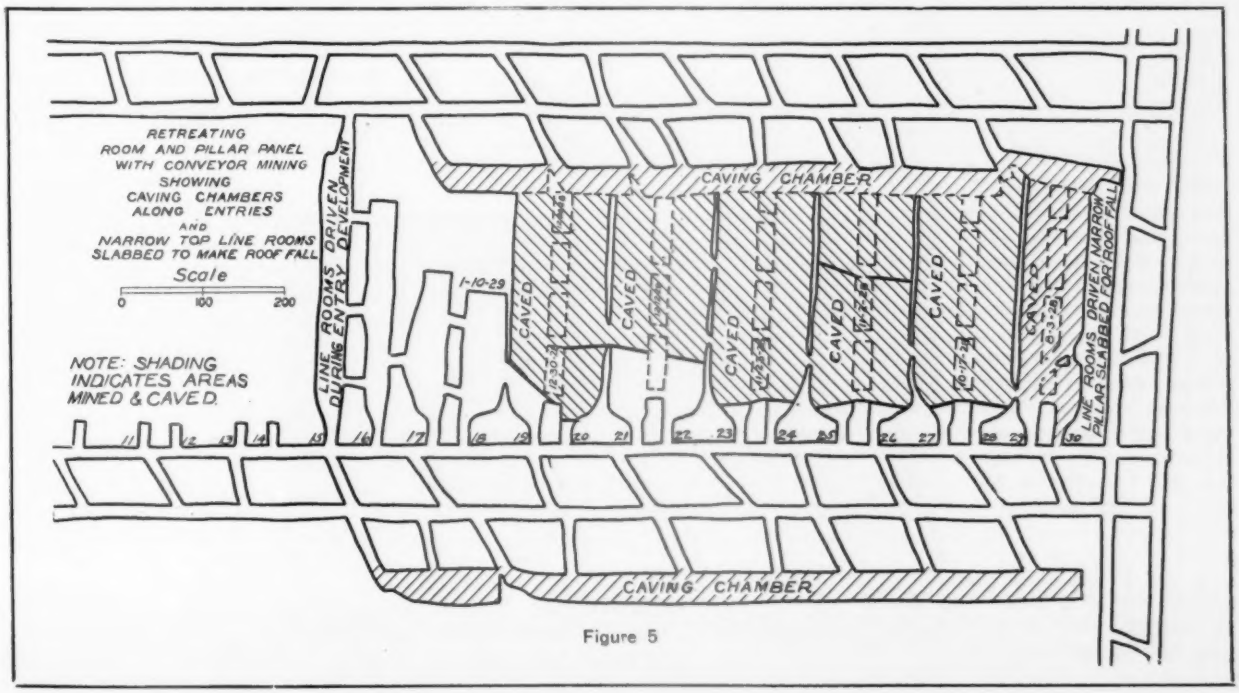


Figure 5

in using 250 volts d. c. at the conveyor drives, compensates for the loss to some extent. The use of compressed air was installed primarily as a safety feature. However, it has been found that it has the advantage of requiring small, light engines for the conveyor drives, and the ventilation of the working faces is improved by the addition of the exhaust air to the regular ventilating current.

In the first operation all labor was paid on a day basis, but during the year 1928 the conveyor men were changed to a tonnage contract rate. Under the present contract system the men employed on the conveyor crew do all work from the cutting to loading the mine cars at the conveyor discharge, and they all share equally in the tonnage rate paid. Usually seven or eight men form the crew for one unit operation—the exact number being more or less optional with the men themselves.

Production Record

The map in Figure 1 shows the conveyor mining which has been carried on in one section of the mine during the year 1928. This work has been done with four conveyor units working on double shift—three operating in rooms and pillars and one driving air courses and caving chambers for the entry development. The following figures give the production by months and the number of days worked in each month during the year 1928:

	Tons	Days worked
January	14,820	26
February	14,010	25
March	16,850	27
April	14,230	22
May	13,005	20
June	18,048	24
July	13,453	21
August	13,690	20
September	14,163	24
October	14,801	27
November	14,940	25
December	15,680	25
	177,690	286

The total production mined by the four conveyor units working double shift figures that an average of 77½ tons per shift of eight hours was mined by each conveyor unit during this period. This figure assumes that all conveyor units worked full time during all of the 286 days that the mine operated, and this average daily production per unit is therefore less than the actual tonnage which is had during the usual full-shift operation. The management reports that the normal full time production from each unit will vary from 85 to 100 tons per shift, but on the contract system if one or more men on the regular crew are absent, their places are not filled unless it is known that the absence will exceed a period of four or five days. During the month of June, 1928, an average of 94 tons per conveyor shift was made.

The production during the year 1928 shows that an average daily tonnage of 621 tons was mined by four conveyor units. As each conveyor unit works two rooms, this means that this daily production was mined from a total of eight working rooms. In hand mining, the management reports that an average daily production of 14 tons is mined from each room during a working shift. At this rate, a total of 45 rooms would be required to produce a tonnage equivalent to that mined from eight rooms with four conveyor units. This indicates that with conveyor mining the working territory is concentrated into about one-sixth of the number of rooms that would be required for hand loading into mine cars. This figure, however, is comparing a double shift conveyor operation with a single shift hand loading operation, but putting both operations on either a single or a double shift basis would indicate that conveyors concentrate the mining territory into one-third of the working places that would be required for hand loading. This comparison applies to the work room only and does not take the entry development into account, but, even so, it indicates that a very high degree of concentration is had with conveyors at this mine.

The management reports that their conveyor operations have proved economical and successful in competing with hand loading under similar conditions. Without quoting cost figures, the proof of this statement is evidenced by the additional units which have been installed at several of their operations and by the underground development which has been made for a continuance of conveyor mining.

OPERATING REPORT

The seam is 4 ft. high and lies fairly level. The coal is of soft structure and has no regular partings but intermittent streaks of impurities occasionally occur. The bottom is of hard clay; the cover varies from 450 to 700 ft. Closed lights are used; the entries are rock dusted and the loaded mine cars are sprinkled at the main line parting.

Since this report supplements Report No. 418, already published, it is not necessary to repeat a description of all the operating details. The sketches already submitted show the mining plan and the installation of the conveyors, and there has been no departure from the methods previously described in the operations of cutting, timbering, etc. The undercut is made with a 6-ft. bar, the coal is shot with permissible explosives and electric firing, wood posts from 3 to 5 in. in diameter are used on about 5-ft. centers in the room advancement and pillar recovery and no timbers are recovered.

The rooms are driven 40 ft. wide with a 20-ft. pillar between and only one pair of rooms is worked at one time in a panel. These are driven up to their full length and the pillars between them are mined before the next pair of rooms is started. Only one unit of conveyor equipment is used in a room panel. In advancing a set of entries, conveyors are used for driving the air course and caving chamber as is shown in Figure 2. The haulageway is driven by hand. Since the rate of advancement with conveyors is much faster than the hand driving rate, one conveyor unit is used to develop more than one set of entries. Usually the air course and caving chamber are advanced about 300 to 400 ft. with one conveyor set-up and the conveyors are then transferred to another panel while the haulway is being driven up.

As mentioned in this report, the conveyor work is now on a contract basis and eight men comprise a unit operating crew. These consist of five loaders, one car trimmer and two cutting machine men. The car trimmer is stationed at the conveyor loading point and one cutting machine man remains in each of the two rooms—cutting and shoveling bug dust, drilling and firing the shots. The five loaders work in both rooms, proceeding from one to the other as a face is loaded out. In addition to this contract crew, the company employs one man who acts as slate picker and usually stays at the mine car-loading point. Under normal, favorable conditions this crew will load out three room faces during an eight-hour shift.

All conveyor mining in entries and rooms is worked on double shift. In the room pillar recovery the two regular crews of eight men each are divided into three shifts so that the pillar extraction will proceed continuously and at a rapid rate. As shown in Figure 3, the average time required to advance a pair of rooms and recover the pillars is less than one month.

The gathering locomotive delivers mine cars in 30-car trips at the conveyor loading point, and these average about one and three-quarter tons capacity. A rope hoist which is operated by the car trimmer moves the trip while the cars are being loaded, and one gathering locomotive will serve several conveyor operations.

Each pair of rooms uses one haulage conveyor—shaking type, compressed-air driven—330 ft. long when at its maximum length; two small air-driven drag-chain face conveyors 36 ft. long, two short cross conveyors—drag chain similar to face conveyors—each averaging about 50 ft. long, two electric undercutting machines, two rotary compressed-air coal drills and one electric-driven rope hoist.

COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

THE STANDARDIZATION OF MINE CAR BEARING MOUNTINGS

By S. M. WECKSTEIN *

Standardization Contributes To Efficiency Through Reducing To Minimum Time Required For Repairs And Replacements—Description Of Typical Examples

ONE of the most remarkable phases of the application of antifriction bearings to mine cars is the rapidity with which their inclusion has come to be an accepted feature of car construction. As a matter of fact, the question of their suitability for the service is largely giving way to the one of how they can be most effectively mounted to meet all the requirements of the service. In this connection, the extent to which antifriction bearings are used has given added importance to two requirements, which, while they may not directly affect the capability of the bearings as far as performance under service conditions is concerned, certainly do affect their suitability from the standpoint of operation as a whole. These two requirements are so closely related that the exact sphere of influence of each is difficult to define, but there is enough difference to render their separate discussion desirable for the sake of clearness.

The foremost of the two, for a good many reasons, is standardization. Operating conditions in mines are such that it is of vital importance that repairs and replacements be made in a minimum of time and with the least expenditure possible for labor or machinery, and often under circumstances that are not of the most favorable towards accurate work. Where the various parts that go to make up bearing assemblies are standardized, these requirements are met to the fullest degree; extra parts may be carried in stock, and therefore are available at short notice, and mutual interchangeability adds considerably to the effective life of the individual parts. In mine practice, where the application of antifriction bearings has made the life of the wheel tread and flange the limiting factor in the life of the running-gear assembly, instead of the life of the axle, this feature is especially important. Bearing parts which have been salvaged from worn-out wheels can be held in stock for replacements, and wheel replacements, even of an emergency character, can be made without disturbing the axle assembly to any material extent.

The other requirement, which is probably of equal importance, is that of ease of assembly. In its fullest sense this requirement implies that not only should the final assembly be a simple matter but that the preliminary operations should be feasible without the necessity for a complicated and expensive set of special machinery or fixtures, or that for highly trained or expert personnel. And, while the standardization of parts is a long step towards aiding ease of assembly, its whole advantage can be lost if the design proper calls for an elaborate series of operations to put the parts together. Therefore, the design must be as simple as is consistent with the qualities of strength and durability required to meet the load and other demands of the service.

Both of these requirements have received considerable attention in the development of the assemblies used in connection with roller bearings. Several distinct types of mountings have been de-

Car equipped with standard loose wheel mounting, with extended axles

* Industrial Equipment Engineer, Timken Roller Bearing Company.

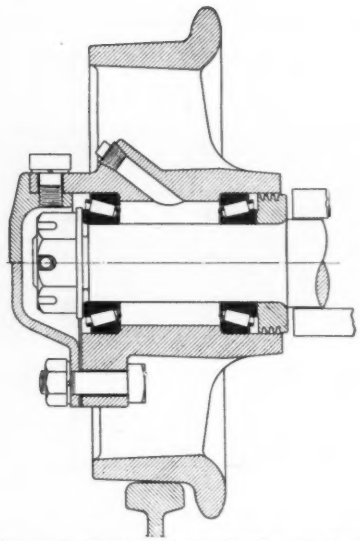


Figure 1. Section of standard parts bearing assembly for a loose wheel mine car which shows its simplicity and the few parts that make it up

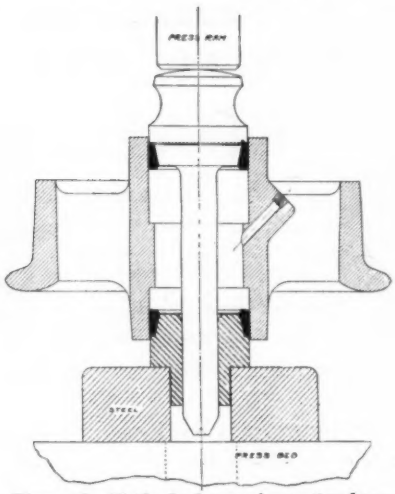


Figure 2. Method of pressing outer bearing races into wheel hubs. This simple fixture is the only mechanical means necessary to install bearings in wheels

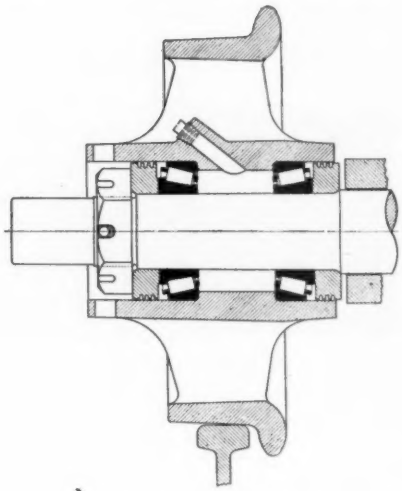


Figure 3. Section of a standard mounting for loose wheels and extended axles

signed to meet different service requirements, but all of them have two points in common, they are made up of standardized parts, and are very easy to assemble and disassemble under the conditions existing in most mines. Parts are standardized in terms of car weight and axle diameters over a range of about 12 weights ranging from 5,000 to 25,000-lb. capacity, and over an equal number of axle diameters ranging from 1½ to 3½ in. The methods of assembly naturally differ for different types of mountings, but all have been made as simple as possible. How these characteristics are obtained in the case of the different mountings is best shown by a description of typical examples of each variety.

The simplest, and probably the most used, form of mounting is that developed for the loose-wheel type of car. A complete assembly of this sort is shown in Figure 1. The standardized parts which make it up comprise two bearing assemblies, a dust collar, which forms the inner closure of the bearing housing, and an adjusting nut, washer and cotterpin.

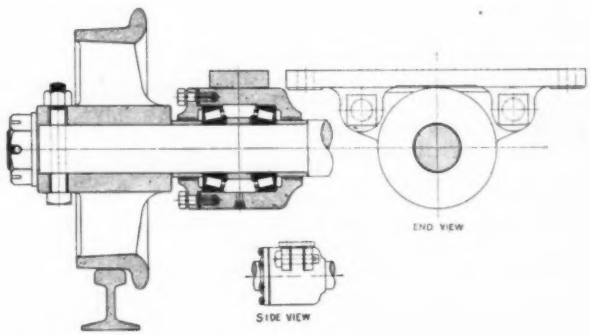


Figure 4. Section of inboard journal bearing mounting employing standardized parts

The simplicity of the assembly is obvious from a consideration of the illustration. The cups, or outer races, of the bearings are pressed against shoulders in the hub of the wheel, this operation being the only one that requires special fixtures (Figure 2). The dust collar is then shrunk on the axle, being located tightly against a fillet machined on the latter, and the bearing cone assemblies given a fit on the axle that is just tight enough to make it easy to assemble and disassemble the wheels. The cone of the inner bearing is located by the dust collar, and that of the outer by the adjusting nut and washer. The assembly, after the cups are pressed into the wheel hub, the dust collar shrunk in place, and the inner cone placed on the axle simply consists in slipping the wheel in place, adding the outer cone, and obtaining the proper bearing adjustment by means of the lock washer, nut and cotterpin.

The closure, which is characterized by the same simplicity, has been designed with two prin- (*Continued on page* 132)

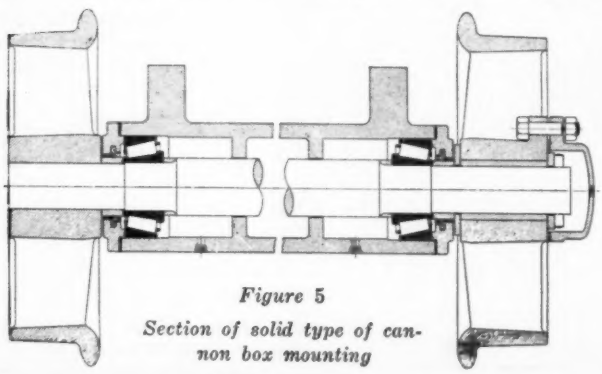


Figure 5
Section of solid type of cannon box mounting

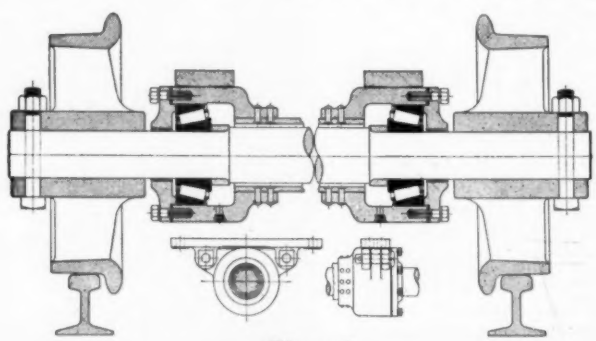


Figure 6
Section of built-up type of cannon box mounting

The above figures show the bearing arrangement and method of providing lubricant storage

THE Developments In The Anti-Friction Bearing Are Thousands Of Years Old—Results Of Investigations Conducted In Connection With Maintenance, Lubrication, Repairs And Amortization As Applied To Mining Industry

DEVELOPMENTS *in* ANTI-FRICTION BEARINGS

By F. E. ERICSON *

ORDINARILY we consider the anti-friction bearing as an entirely modern development, its invention being generally attributed to the bicycle. It is interesting to learn that the endeavor to eliminate friction has received consideration for thousands of years and that the ball or roller bearing today is the outgrowth of this study.

The first wheels were used more than 4,000 years ago, for we know that the Egyptians had chariots of war equipped with them. Wheels and axles of good design were known early in Britain, for Cicero expressed the opinion that there was little in the British Isles worth the trouble of transporting to Rome except the British war chariots, which, from the point of workmanship, were vastly superior to those known to Rome.

The first investigation of bearings of all types was made by the famous painter and scientist, Leonardo da Vinci, painter of the Last Supper, who not only endeavored to study all phases of sliding but also of rolling friction. As may be expected, these researches were scarcely of the high character which are today conducted, but they nevertheless show that friction and its elimination were being generally considered. In one of the many manuscripts left behind by him, Leonardo da Vinci speaks of the "bearing of highest perfection" consisting of either a series of balls or rollers useful for radial movement in clocks, saws, and the rolling out of copper plate. Of this bearing Leonardo writes that "its arrangement makes rotating movement last so long after the power is stopped that it seems wonderful and supernatural."

In the early eighteenth century grist-mill machinery was equipped, in Holland, with antifriction bearings, the bearings being used on both the milling machinery itself as well as on the windmill and the revolving roof of the windmill.

The United States is not without its old application of antifriction bearings. In 1909, when the old Trinity Church, at Lancaster, Pa., was renovated, the weathervane was found to be mounted on antifriction bearings, originally installed in 1794. Despite their age and lack of attention, they operated satisfactorily. Some have given Robert Fulton credit for these bearings, and others Getz, who engraved the seal of the United States. In any event, the bearings functioned so satisfactorily that the new ones now used are of the same construction.

With the advent of the bicycle more serious thought than ever before was given to the elimination of friction. The old types of high wheelers used, in some cases, oil-soaked wood bearings, but this type of bearing was soon superseded by the cup and cone type of bearing which is today in use. The first modern bearing of the construction used in practically all industries was developed about 30 years ago. At that time Professor Stribeck, of the Scientifical Technical Experimental Laboratories, in Germany, conducted a series of experiments which have been used with modifications as a basis for the design and load-carrying capacities of present-day bearings. The universal application of ball and roller bearings to every industry is the best indication of the need and demand to eliminate friction and to reduce maintenance costs.

As in every other industry, the mining field has taken advantage of the economies which may be effected through the use of these bearings. Pumps, blowers, electric motors, mine locomotives, hoists, sheave wheels, and mine cars are all furnished with antifriction bearings. The results which can be obtained from any one of these applications is very well illustrated by considering the mine car.

Some of the very earliest applications of ball bearings to mine cars are still in successful operation. In one of the ore mines in this country for 15 years operation of some 440 bearings in use, it is found that the replacement has been less than 7/10 of 1 percent, or approximately .04½ percent per year. Some rather interesting data on the draw-bar pull in pounds per ton at this mine is given in Table I.

At another mine, after exhaustive tests run over a period of three years, 1,640 mine cars were equipped with ball bearings. Of 6,560 bearings in operation, there has been a total replacement of 18, 8 of which were attributed to accidents in the mines, or the total replacement since July, 1922, of .27 percent.

TABLE I

	Straight roller	Plain roller	Ball bearing
Starting, straight track...	77.82	77.80	34.33
4 miles per hr. straight track	37.80	31.13	15.02
4 miles per hr. on switch.	42.00	37.75	18.43

Were it only for long life which antifriction bearings give with a minimum of replacement, it is doubtful whether the additional cost would be warranted. It has, however, been definitely proven that there is a substantial saving in maintenance and power required. For purposes of test a number of mine cars were allowed to run down an inclined plane, and the distance along the level obtained with ball-bearing-equipped cars were 41 and 85 percent better for the empty and loaded ball bearing mine car, respectively, than for the ordinary plain bearing-equipped car. It was also found that the results obtained when mine cars ran in one direction were not the same as when they ran in the opposite direction. The difference in the case of the plain bearing cars was 22 to 64 percent, but in that of the ball bearing it was only 12 percent.

Of great interest are the results of investigations conducted in connection with the maintenance, lubrication, repairs, and amortization, and carried out along comparative lines for a period of 18 months at the same mine. For purposes of this investigation 381 plain bearing cars and 457 cars equipped with ball bearings were kept under observation, and the results showed a 60 percent saving in favor of the latter. The management of the mine has found that with the low friction properties of the ball

* SKF Industries.

bearing it is possible to increase the number of loaded cars from 22 to 26.

In connection with the power saving and ease in handling of bearings for use in mine cars, we quote from the transactions of the English Institute of Mining Engineers, in a paper given by Applegate and McCauley:

"The saving in power, whether mechanical, animal, or human, is so marked, especially at starting, that it can be confidently asserted that it is only necessary to convert 90 percent of the original number of plain bearing tubs to obtain the same duty. This is due to the fact that, owing to the starting power being less than 50 percent of that formerly required, the acceleration is greater in the same proportion, and as the power required when traveling is less, the journeys of the tubs take a shorter time. The extra duty available from the tubs is also brought out by the fact that a man can handle with ease two ball bearing tubs when he can deal with only one plain bearing tub. This applies also to the haulage performed by ponies. Further, owing to the reduced friction, tubs will travel by gravity down inclines which required power before. Thus with an equal expenditure of power the number of tubs required can be reduced by 10 percent. Hence, where 2,000 plain bearing tubs are in use 1,800 can be converted and will do the same duty, or if all are converted 10 percent more work can be done."

In general, it may be said that the practice in this country is to use the free wheel construction; that is, with the bearings mounted in the wheel itself; whereas in Europe the live axle mounting is used. There are advantages and disadvantages to each type. As far as the bearings are concerned, the problem of protecting them in the wheel mounting is not so great as with the live axle construction, which is natural in view of the fact that in the case of the wheel mounting only one open end cover is required. On the other hand, the live axle construction allows for an increase in bearing capacity and a somewhat simplified mounting, since one bearing can be held to carry the axial load and stabilize the wheels.

A modification of the live wheel construction which has proven very satisfactory and is today used as standard by one of the large eastern mines is the mounting of the two journal bearings in a single housing. This type of mounting has the advantage of keeping the dirt and water out of the bearing. Due to this large lubrication chamber, it is necessary to renew the lubricant only at very infrequent intervals. A heat-treated shaft is employed to prevent any breakage, and from the results which have been obtained so far, both in England and in this country, it appears that a very low maintenance cost is assured.

The service on thousands of these bearings over a period of years indicates that, when properly selected and applied, they will show a very appreciable return, from a viewpoint of long life, low maintenance, ease of assembly, and reduction in friction, on their slight increased cost over plain bearings.

STANDARDIZING BEARING MOUNTINGS

(*From page 130*)

cipal ends in view; the exclusion of all water, dirt, or foreign matter and the provision for storage of a large reserve supply of lubricant. The inner closure is formed by the dust collar, and the outer either by a rabetted cast-iron end cup or one of pressed steel, as the exigencies of the case demand. The closure is designed for pressure grease lubrication, the whole interior of the hub acting as a reservoir, and access being obtained by a hole drilled from the outside.

All these parts—bearings, dust collars and adjusting nuts—are mutually interchangeable on cars of the same capacity rating and axle diameter, irrespective of make. Therefore a new wheel into which the bearing cups have been pressed can be slipped very quickly over an axle assembly without necessitating disassembly beyond removing the adjusting nut and the outer bearing cone. Complete disassembly can be also accomplished very readily, the only operation requiring appreciable time being the heating of the dust collar to permit its slipping off the axle.

A variant of this type of mounting has been developed for use with loose wheels and extended axles (Figure 3). In this case two dust collars are employed, the inner being shrunk on the axle, as in the standard form of mounting, and the outer being a light fit. The washer between the adjusting nut and the outer bearing cone is dispensed with, the nut bearing directly on the outer dust collar, which in turn locates the outer bearing cone.

Although the mountings for cars employed in anthracite and other mines where the loose-wheel mounting is impractical present quite different problems, standardized assemblies have been worked out for several cases, including inside boxes, outside boxes, and cannon box mountings. Wherever possible the same parts have been employed as are used in the loose-wheel mounting, and the same attention has been given towards keeping the assemblies as simple as possible. In the case of the inside journal box shown in Figure 4, the simplicity of the mounting is readily apparent. The bearing cones are given a light tapping fit on the axle, and are located by a series of spacing collars, that also serve to locate the wheel proper. The inboard cup is pressed into the housing, against a machined shoulder, and the outer one is set up by a pilot on the outer closure. The bearings are cup adjusted by means of shims placed between the outer closure and the journal box proper.

Two varieties of mounting have been adopted in the case of outside journal boxes, which are very similar in their general construction; that for the strap-mounted box and that for the lug-mounted box. The general features of these mountings are very similar, the principal points of difference being in the details of the closures. The cups are pressed into the wheel hubs and the cones given a light fit on the axle. The dust collar, which forms the inner closure, is given a tight press fit, instead of being shrunk on as is the case in the loose-wheel mounting. Bearing adjustment is obtained by means of an adjusting nut, washer, and cotterpin.

This method of assembly and fitting of parts has been made necessary because the removal of the wheel involves the removal of the entire bearing assembly from the axle. As it is, once the adjusting nut is removed it is a very simple matter to bump the whole assembly off the axle ahead of the wheel without danger of damaging any of its component parts.

Cannon-box type mountings have also been developed for the fixed-wheel type of car, two designs of this sort being illustrated in Figures 5 and 6. The former shows a solid type of housing, in contrast to the built-up type shown in Figure 6. Two different methods of fixing the boxes to the cars are also illustrated in the two figures. While both types of mounting have a point in common, in that ample provision for lubrication has been made in both cases, the box in Figure 5 is designed to eliminate the necessity of applying an excessive amount of grease. Two different types of closures, both of which have proved very effective in service, are also shown. In Figure 5 the wheels are properly located on the axles by means of spacers against which they are pressed, provision also being made for leaving one wheel loose for cases where cars must operate over tracks where the curves are sharp and excessive sliding of the wheels is likely to occur in consequence. In the mounting shown in Figure 6 the wheels are located on the axles by through bolts which pass through the wheels and axles.

In both cases the bearing cones are press fitted on the axles, and should be provided with a solid backing, either by a proper diameter of axle between fillets or else by means of spacer rings as shown. The cups are fitted into the housings and adjusted by means of shims between the closures and boxes.

ROLLER BEARINGS *as* APPLIED *to* WHEELS *and* JOURNAL BOXES *on* MINE CARS

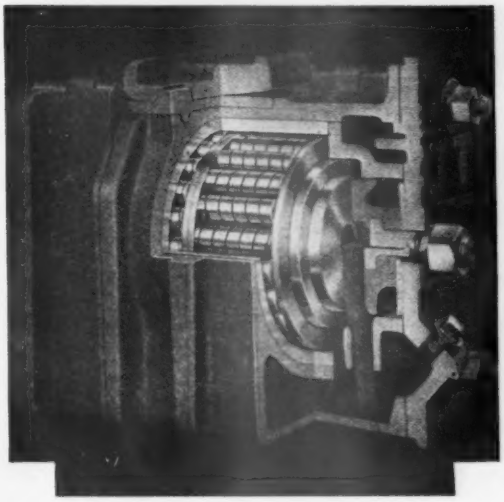


Figure 1. Type of bearing used in railroad service

By R. H. LEONARD *

IF ALL coal beds were of the same thickness, same texture and same pitch, there would probably be some who would not agree that all mine car bearings should be placed in wheel hubs, or conversely, in journal boxes. Nevertheless, the above are some of the variations which gauge the selection of the type of mine car which, in turn, in a large measure determines the most suitable location for the bearing.

Hence we find that the size or gross weight of the car is considered in choosing between these two methods. Looking back a couple of decades ago when Hyatt was pioneering the mine car industry, the first and most extensive use of this bearing was in wheel hubs. Most cars at that time were equipped with axles turned at the ends from square stock and bolted to the body of cars. This, of course, necessitated wheel bearings and it was not until a few years later when the anthracite field was exploited that any extensive journal box installations were made.

However, in the past 10 years the definite trend toward larger and heavier mine cars has resulted in many large car orders being built with bearings in journal boxes instead of wheel hubs. This may be cited as an example of the mining industry's tendency to follow and profit by the practices of railroads. Even the lightest cars used on the old "narrow gauge" roads had their outside journal boxes which appear quite crude when compared with the Hyatt roller bearing journal box now used on over 60 roads in this country. (See figure 1.)

There continues, however, a definite line from which recommendations may be made for either type of installation. As stated before the size and gross weight of the car required is the most important factor.

There are numerous seams of coal being mined in many sections in which only cars of limited size and capacity may be used. If the gross weight of such a car does not exceed 6,000 to 7,000 lbs. it would not be objectionable to place the bearing in the wheel hubs. Nor is it to be said that cars heavier than the above can not be operated satisfactorily without journal boxes for with heat treated axles (250 Brinell) we can point to successful wheel installations in cars exceeding 15,000 lbs. gross weight.

A typical wheel installation is shown in figure 2. The bearing itself consists of a roller assembly, made up of helical wound rollers, right and left hand, alternately assembled, spacing bars, end rings and a planished or split outer raceway. The wheel hub is bored straight to accomodate this outer race which is easily pushed into place. The hub shown is of the closed type but open hubs may be and are readily used.

Type Of Installation Dependent On Size And Gross Weight Of Car—Center Line Of Bearing Should Coincide With Gauge Line—Selection Of Lubricant Also Essential — Coal Mine Rolling Stock Approaching Railroad Standards

The bearing should be aligned in such a way that the center line of the bearing will coincide with the track gauge line. The track gauge line is ordinarily ¼-in. outside of the throat of the wheel, or the junction of the tread and flange.

In wheel hub installations, the length of the bearing has a definite ratio to the diameter of the wheel. The minimum length of the bearing should be 1 in. less than half of the wheel diameter $\left(\frac{\text{wheel dia.}}{2} - 1 \text{ in.} = \text{minimum bearing length}\right)$.

The capacity of this type of bearing for mine car service may be ascertained by computing the projected area of bearing and multiplying by the factor of axles.

The projected area of the bearing is the diameter of the axle multiplied by the length of the bearing, both dimensions being expressed in inches. The projected bearing area of bearing No. 19590 (shown in figure 2) is 17.5 sq. in. (2½ in. x 7 in.).

The factor for axles is given as 100 lbs. per square inch of projected bearing area for .40 to .50 percent carbon content cold rolled or cold turned and polished, axles. The factor is increased to 135 lbs. per square inch of projected bearing area when the axle is heat treated to a Brinell hardness of 250. Then the capacity of the 2½ in. x 7 in. bearing is 1,750 lbs. with cold rolled axles and 2,362 lbs. with heat treated axles.

Thus it is seen that wheel hub installations may be made in cars having a gross weight in excess to the weight mentioned before. With the above formula, it may be seen that by using bearings 8 in. long on a 3 in. axle not heat treated, a load of 9,600 lbs. may be carried and the same bearing with a heat-treated axle will carry a car of 12,960 lbs. gross weight.

Proper lubrication of a mine car bearing is of course essential. Good lubri-

* Hyatt Roller Bearing Company, Pittsburgh, Pa.

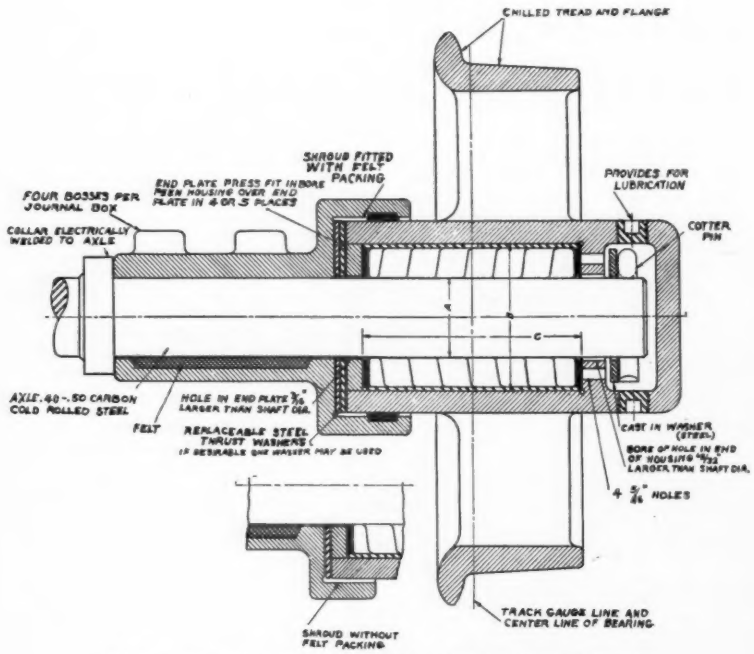


Figure 2—Standard closed-end wheel, 16-in. diameter, with 2½ x 7-in. bearing.

cants are numerous and the same may be said of inferior lubricants. No lubricant except of known good quality should be injected into any bearing. A good lubricant of a consistency close to that of vasoline should be used in mine car bearings.

In the closed hub type as illustrated, a grease plug is provided in the end cap. In the open end type, a hole may be placed in the center of the hub between the spokes. There are three holes in the center of the circumference of the outer race through which the grease thus applied may be forced through the bearing.

The helical wound rollers will distribute the lubricant along the surfaces requiring it, insuring positive lubrication. This feature is shown in figure 3.

Journal Boxes

We have said that the roller bearing journal box was originally used in the anthracite fields. This was due, in part at least, to the conditions in that field which permits the use of extremely large cars or "wagons." Those cars, which often would serve elsewhere as monitors, have shown a predominance in journal boxes, (*Continued on page* 136)

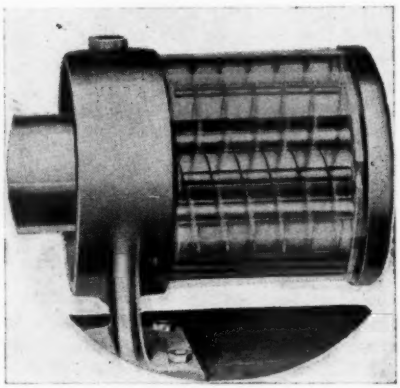
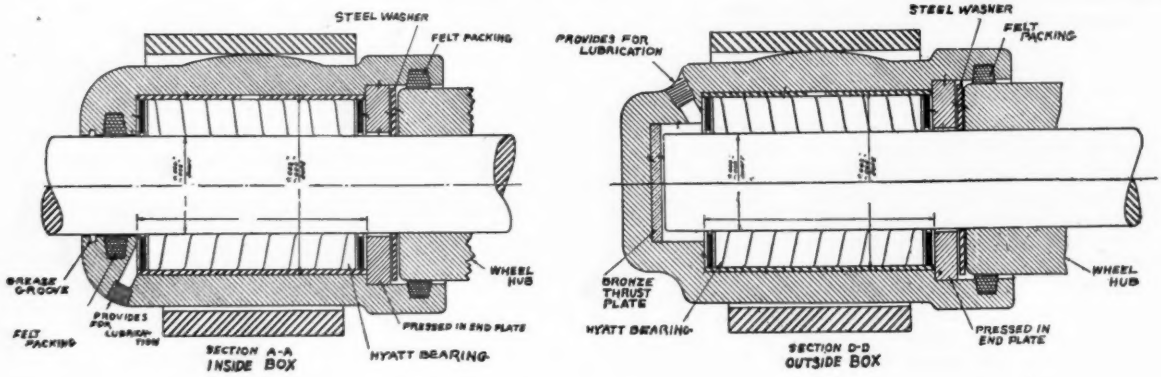


Figure 3



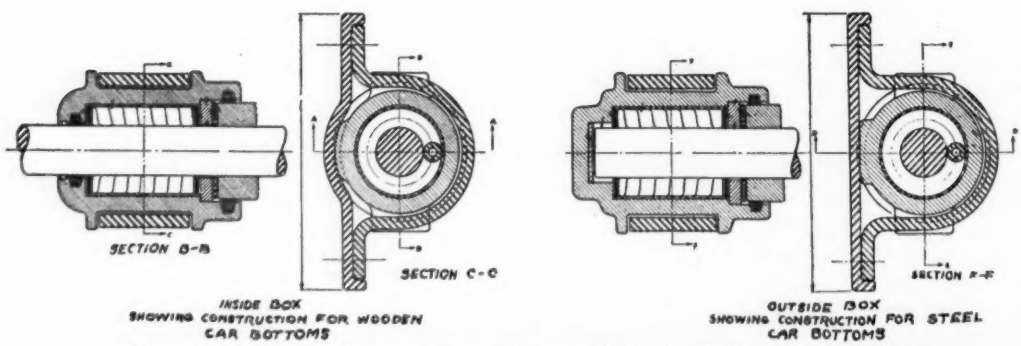


Figure 4—General designs of mine car boxes, self-aligning inside and outside types.

BEARING *on* BEARINGS

By C. P. Daniel *

The Index Of Mine Condition Is The Efficiency Of Its Cars; Of Car Efficiency, The Quality Of Running Gear; Of Running Gears, The Bearings Used —Bearings And Grades Are Inter-related — Anti-Friction Bearings Indicated In 97 Percent Of Installations

SOME interesting facts were recently brought to light in an appraisal of coal mining plants in a certain well-known producing field. Facts, because the appraisal was made by accurate and experienced engineers to be used as a basis for consolidation of the properties, and no pains were spared to make its findings correct and complete. Four separate districts, comprised of new, old, and middle-aged mines, make up this particular field, and its survey fairly presents a cross section of the bituminous coal industry as a whole.

The saying, "Coal mining is largely a matter of transportation," is trite but true, and the all-important transportation unit of coal mining in the mine car or pit wagon. Further, since the mine car must fit in and work with all productive portions of a mine loading, hauling, and dumping equipment, it follows that the clearest single index of a mine's condition, from a cost and production standpoint, is the character, condition and efficiency of its mine cars. Let us consider, then, the mine car situation as revealed by actual appraisal.

A total of slightly less than 50,000 mine cars were listed under headings steel, wood, and composite; and further under each of these headings classified according to type of running gear, as plain bearing and roller bearing.

It is of more than passing interest to note that 13 percent of the cars were all steel construction, 23 percent composite (steel sides and ends with wood floor), and 64 percent were of wooden construction.

In its function as chief transporting element in the chain of production, the mine car's most important part is its truck or running gear. And since the wheel bearings largely determine the ease, speed, and continuity with which cars can be hauled, it is with the bearings that this paper is concerned.

For fully 20 years bearing manufacturers and truck builders have stressed in advertising and by personal appeal the economies of antifriction bearings in mine car wheels. Yet now, in the year of our Lord 1928, with claims proven and promises backed with 10 and 15 year records of money-saving operation, the survey above referred to shows only one-half of the mine cars equipped with antifriction bearings.

To find the bituminous coal industry—in dire straits and hard pressed as it is—taking advantage of but 50 percent of the savings offered by improved wheel and bearing equipment makes it not amiss to restate some of the patent advantages of antifriction bearings as a whole and make a few observations as to different types of bearings and their application to mine cars.

Plain Bearing Wheels

There are some mines where the coal seam dips slightly and all haulageways are graded in favor of the loaded cars. In such mines the haulage problem, aside from returning empty cars, is one of holding back; and from a pure braking standpoint the hard running of the plain bore wheels is an asset. Also there sometimes happens a mine car in which the load carried and the speed maintained is met by a plain bore wheel, with just the right size bore and journal and just the proper balance, which is regularly greased at right intervals with the exact quality and consistency of grease; where service satisfactory to the management has been maintained for 9 or 10 years. Such instances are rare. In most cases a plain bore wheel is a power consuming, oil wasting, short lived, doubtful piece of equipment whose single advantage is low first cost.

Antifriction Bearing Wheels

In the vast majority of cases antifriction bearing wheels lead to certain definite savings.

Savings in power: Starting tests of 5 to 10 pounds drawbar pull per ton of load as against 35 to 65 pounds on plain bore wheels. It is of no use to load a locomotive with more than it can start. A real test, try some plain bore wheels on cars used in connection with storage battery locomotives.

Savings in lubrication and lubricating labor: Compare oiling once in 4, 6, 12, or even 18 months with the ancient and honorable method of a squirt of "black strap" every trip or two.

Savings in time: Cars equipped with antifriction bearings are quick to start, easy to keep at high speed, all meaning more cars per trip and more trips per hour.

These advantages thoroughly established through 20 years of usage are not debatable, so the question narrows down to what type of antifriction bearing and what design of installation gives to the operator the most complete return of the possible savings.

Ball Bearings

"Nothing rolls like a ball." However, the ball bearing has not been largely used in coal mining cars, probably on account of the fact that a ball bearing of sufficient size and with sufficient factor of safety to withstand the shocks and wear of mining service has been priced too high for general acceptance.

Tapered Roller Bearings

Following successful use in automobiles, trucks, etc., there has been, during the past few years, a somewhat widespread use of tapered roller bearings in mine car wheels. The advantage of this type of bearing is that both radial and thrust loads are carried by the rollers. Also that wear can be compensated by take up or adjustment. This adjustment feature is a great advantage, and at the same time a potential disadvantage. When properly tightened by the take-up nut on the axle, the bearing is kept at top efficiency and has long life. But when needed adjustment is neglected the destruction of the bearing is speeded, and experience shows that when the tapered bearing fails it will usually score the axle beyond repair before the trouble is discovered. Another seeming paradox of tapered roller bearing installations is the fact that when the bearings are properly adjusted the wheel gauge is fixed; that is, no lateral play is allowed of the wheels on the axle. This is a decided advantage in maintaining a constant wheel gauge, but in practice, due to this same rigid construction, a severe strain is put upon wheel flanges when the truck

* Vice President and General Manager, Enterprise Wheel and Mine Car Company, Bristol, Va.-Tenn.

strikes a frog, switch or turnout. In the usual loose wheel type of truck the individual wheel has some lateral play which allows it to "dodge" a little and thereby lessen the shock to the wheel flanges. This slipping of the wheel at the axle also lessens the wear on the wheel tread by taking the side slip in the bearing instead of on the tread.

Straight Roller Bearings

Since 1908 straight roller bearings have been used in quantities in mine car wheels. A great many difficulties of design and installation have been met and overcome. The greatest enemy of the straight rollers, which can only carry the radial load, has been the strain and wear from side thrust. This thrust varies with the individual mine, being governed by speeds, curves, loads, and length of trains handled. In some mines straight roller bearing wheels in quantities up to 3,000 sets have given 100 percent service over a period of 14 years. In other mines, with extreme adverse thrust conditions, wheels have failed in one to three years service. The real test, as practical operators agree, is the test in your own mine under your own conditions; then if it works—it works.

Conclusions

When antifriction bearings for mine cars?

About 97 out of 100 installations would pay. Plain bore wheels are recommended only when the mine has four years life or less, or when all grades are in favor of the loaded cars.

How apply the antifriction bearings?

Ninety-five percent in favor of bearings in the wheels. Apply bearings in journal boxings only when the nature of the superstructure or car frame is so much better served by such application that it will offset the increased cost and added trouble of servicing a bearing so located.

When ball bearings?

Not yet indicated for rough and tumble mine car service.

When tapered bearings?

Tapered bearings pay their way when the conditions of service at any individual mine demonstrate that the thrust load is beyond the capacity of the plain thrust bearings in straight roller bearing wheels.

When straight roller bearings?

It is the writer's belief that, except as noted above, the coal industry as a whole will haul the most tons per dollar invested, make the most trips with the least attention, and show the greatest net saving by using a well designed, sturdily constructed, properly balanced and protected straight roller bearing in mine car wheels. This, of course, in connection with a car body of modern design and capacity to suit local conditions.

ROLLER BEARINGS as APPLIED to WHEELS and JOURNAL BOXES

(*From page* 134)

even before roller bearings were known to be applicable to mine cars.

The service in which these cars are placed is truly a test for their running gear. Sometimes, designed with a capacity for a given amount of coal, they are frequently loaded with rock which more than doubles the load. They operate at speeds between 20 and 30 miles an hour over long hauls, first in normal mine temperatures and then in winter temperatures on outside tramways.

This successful performance in the anthracite field was not to be unnoticed in the thicker bituminous fields. At the present time some of the country's largest bituminous mines are hauling their coal in cars with bearings in journal boxes.

Journal boxes may be either the outside or inside type (see figure 4). Car design and personal preferences control this matter. Journal boxes should be self-aligning, being constructed in two parts so as to permit a definite amount of play between the top plate, which is fastened to the car body, and the journal box proper which contains the roller bearing. This permits the bearing and box to move in either a vertical or horizontal position with the axle when passing over uneven rails or around curves. This removes all rigidity from the running gears. As the load line coincides with the center line of the bearings, the weight of the car is evenly distributed. Other features of this type of bearing mounting consists of the ease and economy in replacing wheels without molesting the bearing.

To compare bearing capacities with those used in wheel hubs, use an axle factor of 175 lbs. Axles should be heat treated, as it will be found they are usually required for plain bearing cars in this class of service. Then it is seen that a car with 2½ in. x 7 in. bearings in journal boxes using heat-treated axles may have a gross weight of 12,250 lbs.

Looking into the future, it may be predicted that journal box installations will gain in popular usage. With better roadbeds, heavier locomotives and greater speed, the super car will be extensively used. With it will come a running gear more nearly approximating that which is used in railroad service.

SHAPE OF PARTICLES IN COAL

Poor results in coal washing and ore concentration are sometimes attributed to the presence of flat particles in the feed. In order to estimate the shape of particles in coal more accurately than can be done by visual observation, a screen scale consisting of a combination of square-hole and rectangular-hole sieves is being used at the northwest experiment station of the United States Bureau of Mines, Seattle, Wash. The smaller dimension of the rectangular-hole sieves is 75 and 50 percent of the square-hole sieve with which they are used. Each square-hole sieve product is separated thereby into three shapes of particles which are called "cubical," "prismatic" and "flat."

A separation by this method was made on a coal from Colorado. The sample was first separated by the float-and-sink method into five specific-gravity fractions, as follows: Under 1.30, 1.30 to 1.38, 1.38 to 1.50, 1.50 to 1.70, and over 1.70 specific gravity. The percentage of cubical particles in these fractions was 67.4, 61.1, 54.1, and 35.2, respectively. The tendency toward flat shapes or flakiness increases as the specific gravity of the components increases. The component with a specific gravity under 1.30 contains nearly twice as much cubical material as the component over 1.70 specific gravity, but it had only one-fifth as much flat material. This method of estimating shape gives numerical expression to the common observation that bone and refuse are more flaky than coal. It also provides means for evaluating the effect of shape of particle in any concentration or cleaning process.

FUSAIN (MINERAL CHARCOAL) IN PITTSBURGH COAL

The fusain, or mineral charcoal, content of coal from the Pittsburgh vein is not uniformly distributed, according to the Department of Commerce, which, through the Pittsburgh Experiment Station of the United States Bureau of Mines, has conducted a study of the subject in cooperation with Carnegie Institute of Technology and the Mining Advisory Board. The fusain content has been found to vary from 1.3 to 4 percent, depending on the locality sampled. There are two varieties of fusain; one hard and one soft. The hard variety is high in ash and contains calcium carbonate, with probably some iron carbonate; the soft variety is low in ash and contains no carbonates. In general, the sulphur content found is low, ranging from 0.13 to 1.13 percent. Organic sulphur varies from 0.13 to 0.27 percent. Fusain is easily identified by the microscope; at 70 diameters it presents a fibrous appearance (woody fibers) which gave rise to the German term "fasserkohle."

The Bureau of Mines has recently issued a report entitled "How the U. S. Bureau of Mines Conducts its National or International First-Aid Contests," by J. J. Forbes. The report outlines the methods employed and working problems in first-aid.

Figure 1

The COORDINATION *of* MINE *and* FAN CHARACTERISTIC

By J. R. ROBINSON *

Airway Extensions And Regulation Of Pressure Are Complicated Functions Of Ventilation —Scientific Research Shows Impulse Fans To Excel Only In Quantity Of Air Per Revolution — Inefficient Ventilation Frequently Not The Fault Of The Fan

THE subject of mine ventilation is again coming before the mining people with increased vigor. The cause of this renewed interest may be traceable to the number of disasters that have occurred recently with the great loss of life, or it may be an awakened spirit of desire to make life and health better than before. I am hoping it is the latter, for this spirit of welfare is a more permanent thing than the shock and fear that follows disaster.

The September issue of THE MINING CONGRESS JOURNAL carries an article bearing on this subject by Mr. George S. Rice, of the Bureau of Mines. The tenor of this article is the fluctuation of pressure of mines where the quantity of air is the same. Mr. Rice enumerates seven causes for fluctuation of pressure. There is another, the increased length of air ducts due to the continuance of the mine.

This lengthening of the mine ducts would increase the pressure directly proportional to the added length, if there were no other factors to be considered, but when certain airways are extended farther than others, or are driven with a smaller cross section than the others, then regulators are used which increases the pressure of the air on all the contiguous airways to the pressure required to pass the air through the most difficult one. It must be borne in mind always that the air will take the path of least resistance. Regulators are very often the cause of the excessive pressures in many mines. If these regulators were removed, however, there would be insufficient air in many working places, unless auxiliary fans are used in such places where the quantity of air is insufficient. I know the antipathy of many mining men to these fans, and I shall not discuss them here.

In Mr. Rice's paper the statement is made that multi-blade impulse fans might be considered best for mines with practically constant conditions. A few years ago I would have agreed with that statement, but recent research work has proven that this statement is erroneous, at least with respect to the various fans common to American mines. I have found in my recent investigations of many makes and types of fans that when rigid and accurate measurements are made by the same men and with the same instruments and methods that mine fans are not nearly so efficient as they are supposed to be.

The former inaccuracies were due to many causes — instruments not calibrated, improper timing, very rough and inaccurate measurement of airways, a sectioned airway with the anemometer held a definite time in each section to ascertain the mean speed. Professor Callen, of the University of Illinois has done some very careful and reliable work along this line. His observations have checked up mine, although I have not gone into this matter with the care which he has used in his observations.

In the earlier test records temperature and barometer corrections were rarely used. In fact, the records made a few years ago for fan tests were largely guesswork with the guess in favor or against the manufacturer in accordance with the bias of the mine management. It has been my aim to reduce these measurements to as near absolute accuracy as possible and to avoid bias. I have had the measurements taken by disinterested men, whose sole aim was scientific accuracy. After submitting my own various designs of fans to these disinterested men and having them apply the same methods to fans of other makes of the same type, my records show that the impulse fans referred to are very much less in mechanical efficiency than the flat blade or backward curve. This impulse fan has just one feature in which it excels. It is much more efficient in quantity of air passed per revolution of the wheel. When the backward curve wheel delivers 100 to 200 percent of its volume per revolution, the forward curve will deliver 300 to 500 percent. The forward curve, therefore, has the capacity to do a great deal of work with a small wheel, but it does it at the expense of power, and, after all, a mine fan is in use so constantly and for so long a time that

* President, Robinson Ventilating Company, Zelienople, Pa.

Figure 2

mechanical efficiency is, or ought to be, the determining factor.

In this connection, there are shown in Figures 1 and 2 two fans made for the same people to do the same work and used in adjoining mines. The first (Figure 1) is made from a photograph of a forward curve fan. This fan was designed for 100,000 cu. ft. of air per minute at 3 in. of water gauge. It was guaranteed for 75 percent mechanical efficiency. I submit the record of this fan made by the mine management. It is as follows:

> 300 r. p. m., 84,500 cu. ft. of air, 3.2 in. W. G., 71 hp. motor input, 42.6 hp. in air.
>
> Seventy-one horsepower electric input, allowing 90 percent motor efficiency and 95 percent chain efficiency, would make the mechanical efficiency of the fan 70 percent.

Figure 2 is a photograph of the backward curve fan referred to above. It was designed for 100,000 cu. ft. of air per minute at 3 in. of water gauge. It was guaranteed for 70 percent mechanical efficiency with absolute accuracy of anemometer and sectioned airways.

I submit the record of this fan made by the mine management. It is as follows:

> 410 r. p. m., 102,500 cu. ft. of air, 2.9 in W. G., 70 hp. motor input, 47.8 hp. in air.
>
> Seventy horsepower electric input, allowing 90 percent motor efficiency and 95 percent chain efficiency would make the mechanical efficiency of the fan 80 percent.

The measurements of the air was the usual method of moving the anemometer about in the airway but not sectioning the airway. The measurements were made by the same men with the same instruments and methods on the same day and were made for purposes of comparison.

The backward curve fan was guaranteed for 70 percent mechanical efficiency with a sectioned airway and would have made good, for it had a large factor of safety. The forward curve fan fell down on its guarantee, and with a sectioned airway would undoubtedly have fallen below 60 percent mechanical efficiency. These records are given as an illustration of the mechanical efficiency of these two types of fans. There are other valuable features of the backward curve fan that will appear later.

In this same September issue of THE MINING CONGRESS JOURNAL there is an article describing the ventilation of the Copper Queen mines, Bisbee, Ariz., by J. B. Pullen. This is a complicated ventilating problem, as you will see if you read the article. I am chiefly concerned with the primary fans. In table No. 1 the theoretical capacity of these fans is given, as well as the operating capacity while on the mine ducts. This table is given in Figure 3.

You will note that all the fans fall short on the delivery of air as well as on the pressure. The fans are well known makes of standard fans and the manufacturers undoubtedly know the capacity of these fans at a given speed, so that the rating is not theoretical but actual. Then why this misnomer? And why do the fans not come up to their rated capacity? Unfortunately the speed of the fan was given for the rating and not given when working on the mine. From the table and the observations of the actual performance of the fans, it seems that these fans are impulse or forward curve fans, for they conform to the performance curve of such fans. Figure 4 shows a performance curve of a typical forward curve fan. They vary somewhat according to the pitch forward and also as to scroll design, but this will serve our purpose in the investigation of this table.

There are many here, no doubt, who require some explanation of this graph to get a fair understanding of it, and for their benefit I shall make a few remarks about the process involved in obtaining such a curve, even if it does seem tedious to those familiar with such performance curves.

The bottom horizontal line, which is the base line of the graph, is used to measure off the quantity of air. The unit of measurement is usually an inch. In mine work the air unit is thousands of feet. This base line is the line of absiscae. The vertical lines are the ordinates and measure the pressure or water gauge, the horsepower and the efficiency, all of which is based on the quantity of air delivered by the fan. To get the points on this curve so as to plot it and draw curved lines through these points, a duct is connected to a fan, and while the fan is at constant speed the pressure in the duct is changed by means of shutters. The operator can change the shutters at will, and increase or decrease the quantity of air flowing or change the pressure as he desires. To

THEORETICAL CAPACITIES OF PRIMARY BLOWERS

Blower	Make	Design	Size	Volume	Pressure	Hp. Required	R. p. m
1,000 Sacto	Sirocco		7	35,000	2½"	35	451
1,400 Dallas	Sturtevant Multivane	3	11	106,000	3"	100	360
1,500 Sacramento	Sturtevant Multivane	2	11	95,800	2½"	75	329
1,600 Sacramento	Sturtevant Multivane	3	12	131,000	3"	125	324

ACTUAL OPERATING DATA

Blower	Make	Design	Size	Motor	Volume Delivered	Static Pressure	Hp. Consumed
1,000 Sacto	Sirocco		7	40 Hp.	32,000	1⅝"	26.8
1,400 Dallas	Sturtevant Multivane	3	11	150 Hp.	72,500	2-3/16"	57.9
1,500 Sacto	Sturtevant Multivane	2	11	50 Hp.	77,000	2"	45.0
1,600 Sacto	Sturtevant Multivane	3	12	150 Hp.	112,000	2⅛"	72.2

(Operating data taken from test made January, 1928)

Figure 3

begin the test he gets his fan running at the desired speed, then closes his duct so that no air will flow, then reads his pressure, which is the total static water water gauge. This is the zero point of the curve for the air. The shutters are opened as much as desired and the quantity of air and the pressure is read. This gives a point on the quantity pressure curve. As many points as may be desired can be obtained by this method, and the data thus obtained gives the information necessary to plot the performance of the fan. At the same time as the quantity of air and the water gauge is read, the horsepower input should be read. This gives the data for the fan's mechanical efficiency.

Let us now examine the graph (Figure 4). You will note that these curves are plotted for a fan designed for 100,000 cu. ft. at 3-in. W. G. The fan should run at the peak of its performance when delivering this quantity and pressure. Now, suppose the mine or duct is changed by falls or doors or regulators which increase the resistance, and the air falls off to 75,000 cu. ft., or three-fourths the quantity, the pressure will fall off also. The mechanical efficiency will drop from about 60 to 40 percent, which is characteristic of the forward curve fan.

Examine the first fan on the table, 35,000 cu. ft. at 2½-in. W. G. rating, 32,000 cu. ft. at 1⅝-in. W. G. actual performance. Rated at about 39 percent mechanical efficiency, it drops to about 30 percent mechanical efficiency in actual performance. The other fans perform in like manner. You wonder why: Well, it is characteristic of this type of fan,

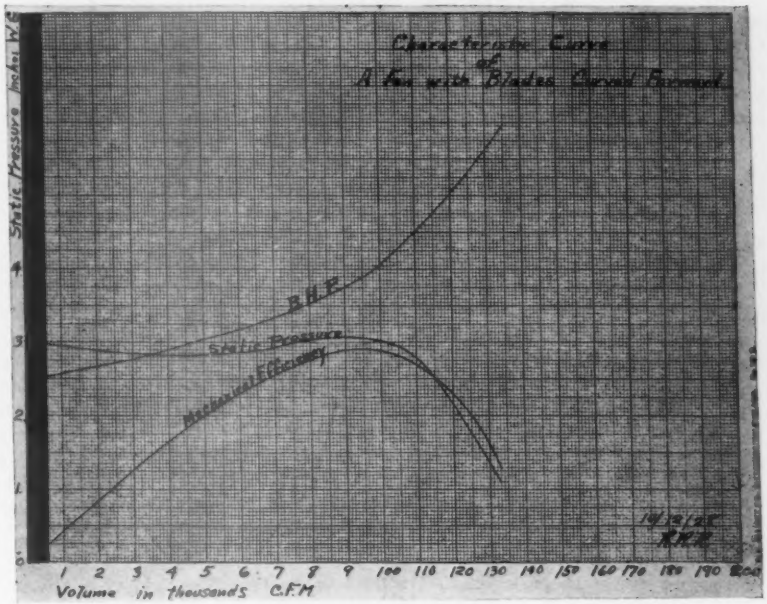


Figure 4

when resistance is greater for a given quantity of air than this type of fan is designed for, it performs back on the curve toward the point of origin and loses in pressure as well as in quantity of air. The remedy for this is to remove the resistance in whatever manner is found most expedient. Failing in this, the remedy is a new fan suited to the conditions of the duct or mine, so that the new fan will perform on the peak of its performance curve. The waste of power in such fans as are described in this table, if saved, would pay 100 percent or more on the value of the fans every year of their operation. Are you looking for 100 percent investments? If you take a look at your mine fans, you will be surprised at what you are losing. It may pay best to stop the leaks or change the doors, regulators, etc., or clean up the falls in your airways. Sometimes it is advisable to cut into the general air current some airways that are not in use. Sometimes there are places necked down where the speed of the air is excessive. These places may be enlarged. By going over the entire duct system ways may be discovered to reduce the mine resistance and make the mine characteristics what they were intended to be when the fan was placed on the mine. This may make the fan perform so that a new one is not necessary. Failing in all these and a new fan becomes necessary, then such a fan as will meet changing conditions of pressure should be sought. The performance curve of such a fan is shown in Figure 5.

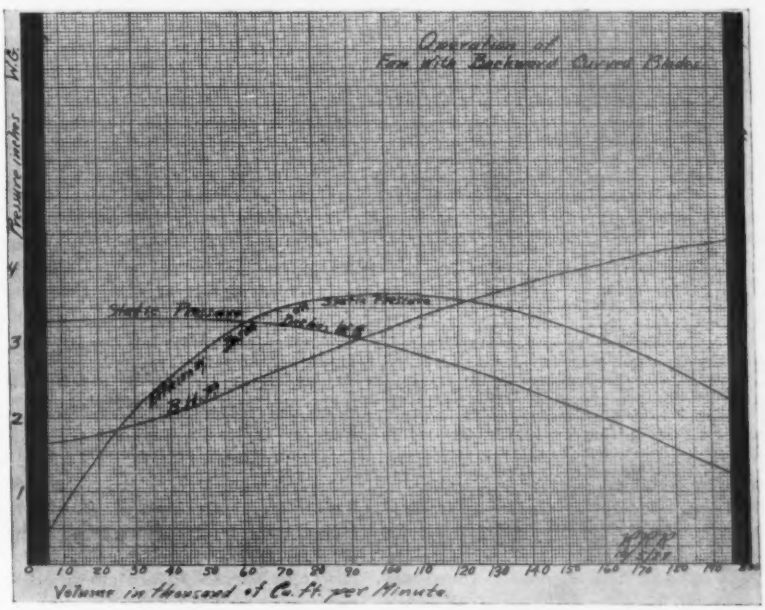


Figure 5

Examine this curve carefully. It is characteristic of a backward curve fan. It is plotted for 100,000 cu. ft. at 3-in. W. G. You will observe that the quantity pressure curve rises slightly from the shut off until near the peak of the mechanical efficiency and then drops off gradually. You will note that the mechanical efficiency curve is much flatter than the similar curve for the forward curve fan. You will note also that the horsepower curve is quite flat and rises slowly and all the curves are showing a creditable performance when the pressure is released and the air passes through the duct or mine more freely. We have found in our research work that

we can change the speed of this fan and maintain the same quantity of air against a pressure varying 600 percent and still maintain a mechanical efficiency of upward of 65 percent.

I want now to discuss with you a factor in mine ventilation which is nearly always neglected.

The various lengths of ducts or airways within the mine with the obstructions and rubbing surface constitute the water-gauge pressure as customarily taken, which is the static head. There is in addition to this pressure one other, the velocity head, which is usually neglected in mine ventilation, but which is a very important factor in making calculations for power. It is also a large factor when the air shaft and airways are small.

This can be illustrated by comparing an air shaft with a cross-sectional area of 100 sq. ft. with one of 200 sq. ft. Suppose we desire to pass 400,000 cu. ft. of air down a shaft of 100 sq. ft. area. The velocity has a mean speed of 4,000 ft., which is about 1-in. water gauge when reduced to pressure. If we pass the same quantity down a 200 sq. ft. shaft, the speed will be about 2,000 ft., which is about ¼-in. water gauge. The larger shaft in this case can pass the 400,000 cu. ft. of air per minute with a saving of ¾-in. water gauge in velocity head, and there would be no appreciable increase in the static head, so that in power there would be a saving of 47.3 hp. in the air which, with the loss of efficiency of the fan motor and drive, would be about 80-hp. input.

In the calculations for ordinary mine ventilation this velocity head would be entirely neglected and would make the fan or fan unit seem to be very inefficient when they might be doing all that could be expected.

It is not often that 400,000 cu. ft. of air per minute would be driven down a shaft 100 sq. ft. cross-sectional area. I know of a case, however, where a coal company attempted to drive 400,000 cu. ft. per minute through a shaft with a 72-ft. area.

This velocity head, of course, must be created in the fan, but with a properly designed discharge a large part of this velocity head can be transformed into static head when the fan is blowing by gradually enlarging the discharge area and not choking it down again. Slowing down the air in large pockets in the airways and then increasing the speed again in constricted airways is very detrimental to the quantity of air and also to the power used.

This velocity head is often encountered within the mine and not recognized. All of you who are familiar with mine air measurements are aware that the cutting in of a parallel heading will increase the total quantity of air flowing, although the velocity is reduced in the first heading and the second heading may not be in very good shape. The rubbing surface is increased, but the resistance is decreased, as the square of the velocity and the rubbing surface makes resistance in direct proportion. Due to this property of the flow of air, it is well to watch the speed of the air flowing through the airways with great care.

The quantity of air may be increased in nearly every mine by following the current from the intake and observing the speed of the air with an anemometer. It is a rare thing that a split requires more than 25,000 cu. ft. per minute, and in a 50 sq. ft. airway the speed should not exceed 500 sq. ft. per minute. Where the speed exceeds 500 ft., means may be taken to reduce this speed by shunting the air to other splits.

At the Pine Hill Coal Company plant, Minersville, Pa., the writer made an examination of their mine last winter with a view to increase the quantity of air passing through the mine. This mine is in the anthracite coal and several seams are worked. The levels are driven through the rock, and in places they were constricted so that a high velocity head was developed.

The mine was ventilated by two fans, one blowing and one exhausting, both on the same air circuit. The blowing fan at the time of my visit gave 52,145 cu. ft. at 1.25-in. W. G. At the present time it is passing 94,500 cu. ft. at 2.90-in. W. G.

The fan is running at the same speed but, due to enlarging the airways, the air flows more freely and the fan is working out on its performance curve more nearly at its peak. This fan is a forward curve fan, and is showing the same characteristics as those discussed above.

This fan is delivering its air to the exhaust fan, which picks up the air at a point somewhere between the two fans and exhausts the air from the mine. The exhaust fan at the time of my visit gave 109,340 cu. ft. of air at 2.4-in. W. G., 150 r. p. m. At the present time it is passing 144,171 cu. ft. of air at 2.6-in. W. G., 250 r. p. m. This fan was speeded up to take care of the increased volume owing to the fact that the orifice of passage of the fan was smaller than the orifice of passage of the mine after the changes were made within the mine.

These changes consisted largely of increases in the constricted areas and a rearrangement of certain airways to reduce the velocity.

The exhaust fan mentioned above lost its velocity head in the short stack. This fan was extremely wasteful, owing to the fact that it was performing too far out on its performance curve and also to the fact that there was a high velocity head within the mine, which was not accounted for in the calculation for power and efficiency.

In reviewing these various fan performances I observe that the quantity of air and the pressure or water gauge required to propel the air varies greatly. To enable us to visualize this feature of the mine and detach it from the fan, Murgue devised his formula for the equivalent orifice of the mine. It has become obsolete to a certain extent. Some engineers have set it aside because it is not quite accurate. Well, I am not worrying about its absolute accuracy. It is only a relative thing, anyway. What I want it for is to visualize the hole through which I have to force the air. If I have to force 200,000 cu. ft. of air per minute through the mine at a 4-in. water gauge, I apply the formula—

$$.0004 \times \frac{200{,}000}{4}$$

and I find I have a hole of 40 sq. ft., or a 4 by 10 ft. entry, and if I can force 200,000 cu. ft. of air per minute through the mine at 1-in. water gauge, then I have a hole of 80 sq. ft., or an 8 by 10 ft. entry. This is a good way to visualize the size of the necessary passageway for the air under the different conditions of pressure.

From the foregoing discussion it will be seen that a mine is a huge duct, or a series of ducts, with certain characteristics for given quantities of air. These characteristics as to pressure vary from time to time. That this pressure usually increases as the mine advances toward the boundary lines, and again decreases as the withdrawal comes away from the boundary lines, unless, as sometimes happens at such times, the air is restricted to certain splits, and regulators placed in the splits where not so much air is required. This constant change of pressure is usually met by changing the speed of the fan if the quantity of air remains constant. Owing to the different characteristics, tests of some of the fans will require a greater range of speed than others. Some will require much more power to effect this range of speed than others. Some will be much more efficient than others during this change of speed. The performance curve of each fan will show the engineer what effect the change of mine pressure will have on the performance of the fan. It is a well-known fact that no going mine continues long to have the same pressure with the same quantity of air. This makes it imperative for the engineer who is seeking the most rigid economy of power to carefully calculate the changes his mine may take as it proceeds and use the fan whose characteristics best suit these changing mine conditions.

Our greatest trouble at this time in fitting fans to mines is that the mine engineer, while he may have a reasonable vision of what he may have in his changing mine conditions and may visualize the characteristics of his duct, knows nothing about the characteristics of the performance of the fan he contemplates using, and, on the other hand, the manufacturer of the fan, while he may know the characteristics of his fan, almost certainly knows nothing about the characteristics of the mine he furnishes the fan for. Indeed, the mine engineer rarely discusses with the manufacturer the character of the mine ducts or the performance of the fan. He wants a price on a fan, unaware that a fan that does not suit the conditions of his mine as it changes from month to month will most undoubtedly waste in power through its faulty performance the entire value of the fan in a few months of service, and yet the fan may be a very good fan.

Figure 6 is a photo of a fan at Grant Town, W. Va., on the No. 1 mine of the New England Fuel & Transportation Company. The original fan was a 10-ft. Robinson forward curve of the ordinary mine type. This type has been in use for 25 years. This fan was equipped with a 200-hp. motor geared to fan with a set of herring-bone gears. The fan was installed in 1923 with rated capacity of 250,000 cu. ft. at 2.5-in. water gauge. On October 19, 1927, this fan was passing 186,000 cu. ft. at 2.6-in. water gauge and using 209 hp. The mine was then producing 3,300 tons of coal per day of eight hours. It was desired to increase the tonnage to 4,000 tons per day and 186,000 cu. ft. was not sufficient air for such tonnage. The management proceeded to install overcasts and close up leaks and make more splits, so that on March 28, 1928, the mine was passing 234,000 cu. ft. at 2.7-in. water gauge with 190 hp. The fan was running at the same speed as before.

It will be seen from these records that the changes in the mine had brought the ducts to near about the conditions anticipated when the fan was installed, so that the mine characteristics and the fan characteristics were nearly mated and the fan was performing with reasonable efficiency. Had the management been content with 4,000 tons per day, this fan would have been sufficient and economical, but it was desired to put the tonnage up to 5,000 tons, and for that production 275,000 cu. ft. of air were required.

It was decided that a new fan should be installed, and that this new fan should be of the backward curve type, so that the variations of pressure and quantity should be taken care of in the most economical manner. With this in view, a fan 11½ ft. in diameter was installed with a 350-hp. slip-ring motor, direct connected to one end of the fan shaft, and the original 200-hp. motor and gear drive connected to the other end of the shaft. A detachable coupling on each end of the fan shaft permitting of either motor operating the fan.

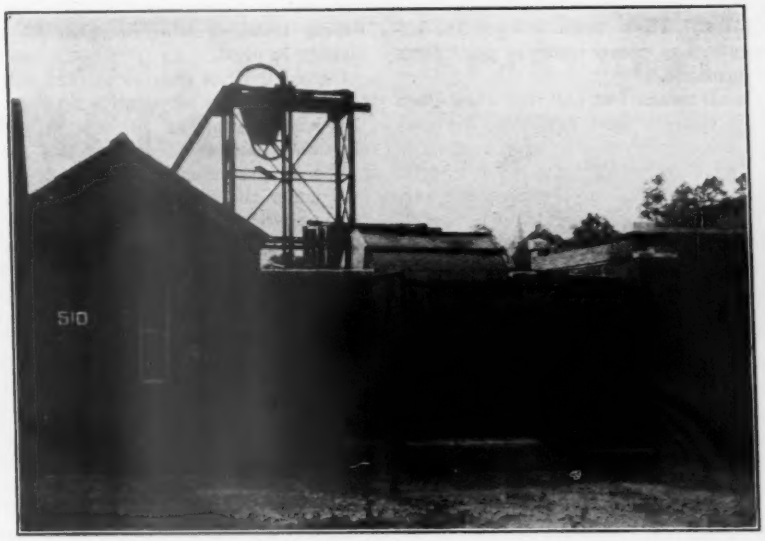


Figure 6

This fan was put into service about the 1st of July, 1928, and has been running at full speed with the 350-hp. motor driving it since starting. The fan is passing for daily use of the mine 290,000 cu. ft. at 4.8-in. water gauge with 314-hp. electric horsepower input.

The mine management desired an efficiency test of this fan, and secured the services of Mr. C. M. Means, Pittsburgh, Pa., for the electric input and Prof. Thomas G. Estep, of Carnegie Tech., for the air input. They, being unbiased professional men, rendered their report, which is as follows:

Quantity of air Cu. ft.	Water gauge Total	Horse-power in air	Horse-power input to motor	Mechanical efficiency
289,000	4.8"	218.5	314	69.6%
275,000	4.9"	212.1	299	70.9%
262,000	5.0"	206.5	286	72.2%
212,000	5.1"	170.4	263	64.7%
150,000	5.25"	125.0	242	51.6%

Fan and motor at constant speed.

It will be noted that the mine conditions are such that the quantity of air is 289,000 at 4.8-in. W. G. To get the proper points to make the performance curve brattices were placed in each main airway to put back pressure on the fan; the air and pressure were measured with each change of these brattices. It will be observed that the resistance which represents falls or regulators or other obstructions may be such as to reduce the quantity of air as much as 50,000 cu. ft. without loss of the mechanical efficiency, and further that the pressure or water gauge rises as the resistance increases and the quantity falls off.

If the New England Fuel & Transportation Company should increase the tonnage of this mine to 7,000 tons daily, it would then require 350,000 cu. ft. of air per minute with the same proportionate resistance as now obtains. The present fan will pass the air by speeding up to about 310 r. p. m. and will continue its present high efficiency. To accomplish this a larger motor can be placed on the shaft end now connected to the 200-hp. motor.

The 350-hp. slip ring variable speed motor was rated at 93.5 percent mechanical efficiency at the peak of its performance curve, and this was used in making the performance curve of the fan. There was no drive to be accounted for, as the motor was direct connected.

The airways were sectioned, and the anemometers were held a definite time in each section. The anemometers were afterwards calibrated and the air speeds corrected to the calibration curve. The temperature of the air was checked back to 68 degrees F. and the barometer pressure also checked. Such a field test as this one is difficult to get with absolute accuracy, as there are numerous leaks of air about such a large installation, which makes an unknown loss of pressure that can not be accounted for. In a laboratory test the duct can be made bottle tight so that there will be no loss of pressure. I am calling your attention to this feature of any test you may desire to make on your fans, so that you will not expect absolutely as much efficiency from your fans as you get from a labora-

tory test. These small leaks in the aggregate may mean much to your fan's performance.

By all means test out your fans often and determine what value you are getting in quantity of air and pressure for the input power you give your motors. You may be able to change the conditions of your mine by cutting into your air circuit such passages as are at present useless, or you may remove regulators or again enlarge some constricted air passages, or possibly stop up enough of leaks to solve your problem. If these things are accomplished and your fan afterwards performs with good economical results, you may not need to change your fan. It is well to bear in mind, however, that most fans that are at present operating on mines are very wasteful of power. The saving in the power bills which can be accomplished by a well-engineered fan replacing a wasteful one will in many cases pay for the entire installation within one year.

GREATER INTEREST SHOWN IN GOVERNMENT'S STANDARDIZATION WORK

That the individual is taking a greater interest in the work of the United States Department of Commerce in assisting American industry to eliminate waste, through simplification and standardization is evidenced in a report just made public by the department, reviewing the progress report of this group for the fourth quarter of 1928.

According to this report the number of acceptances for simplified practice recommendations increased during the quarter from 12,342 to 14,190. During the calendar year 1928 the total number of acceptances increased from 8,546 to 14,190. During 1928 industry developed 22 new simplifications, under the auspices of the department. There are more than 100 effected simplified practice recommendations.

After a proposed simplification is approved at a general conference of interested manufacturers, distributors and users, it is then sent to the industry for signed acceptance. When the Division of Simplified Practice has received signed acceptance pledges from at least 80 percent of the industry, by volume of annual output, the recommendation is then endorsed and published by the Department of Commerce. These recommendations are subjected to periodical review or audit, which not only gives the industry concerned an opportunity to determine the support given its program, but also the opportunity to revise or modify it, if changes in the industry so warrant.

Of the more than 100 developed simplified practice recommendations, 89 have received sufficient endorsement from industry to warrant the department publishing them, of which number 84 are already in print.

During the last quarter of 1928 industry asked for the cooperative services in the consideration of 18 new proposed simplified programs. During this same period 10 preliminary conferences were held under the auspices of the Division of Simplified Practice for the purpose of considering proposed simplified programs. Four general conferences in the same quarter gave informal approval to four simplified practice recommendations.

Spread over the 12 months of 1928 industries that had adopted simplified practice recommendations, reviewed 24 of these programs to ascertain the average degree of adherence or support, that each received, which was 87.03 percent.

Discussing the rapid progress that has been made in promulgating simplified practice since the establishment of the division in November, 1921, Mr. Hudson said that during the last quarter of 1928 the movement had received favorable editorial comment from almost 100 newspapers throughout the Nation, as well as 3 foreign countries.

In addition to covering the progress made during the last quarter of 1928 in the field of simplified practice, Mr. Hudson's report to the Director of the Bureau of Standards, also included the work being done by the American Marine Standards Committee, the Commercial Standards Unit, and the Division of Specifications.

The Commercial Standards Unit is the newest addition to the Bureau of Standards, having been formed in the fall of 1927. To date industry has approved 12 commercial standards of which number 6 have been accepted by industry. Before a commercial standard is published by the Department of Commerce the standard must be accepted in writing by at least 65 percent of the industry by volume of annual output.

One of the big projects undertaken by the Division of Specifications is the promulgation of lists of manufacturers willing to certify to the purchaser that the goods produced by the manufacturer is in conformity with the developed commercial standard for that commodity, or a United States Government master specification. To date more than 2,000 separate manufacturing firms have expressed their desire to be placed on these lists, which cover 248 commodities.

The ever-increasing interest that the individual is taken in the department's elimination of waste program is best shown by the fact that during the last quarter of the year 95 representative business men and women visited the Division of Simplified Practice for first-hand information concerning the work, said Mr. Hudson; of this number 5 were from foreign countries.

NATURE AND USES OF FLUORSPAR

Fluorspar, or fluorite, is a nonmetallic crystalline mineral that usually occurs in glassy, transparent isometric crystals, largely cubic, or in cleavable masses. Less commonly it has a granular or fibrous structure, and occasionally it is banded. Fluorspar has a specific gravity of 3.2, is brittle, has a hardness of 4, and can easily be scratched with a knife. Fluorspar is a mineral of many colors, ranging from clear, colorless, or slightly bluish, and glasslike, through various striking hues, of which purple and green are most common; much of it is white and opaque. Chemically it consists of calcium and fluorine in the proportion of 51.1 to 48.9.

Fluorspar has many uses, but its most important use is in the manufacture of steel by the basic open-hearth process, says the United States Bureau of Mines, in the statistical report on production of fluorspar and cryolite in 1927. It is also used in the manufacture of alloy steel and ferro-alloys by the electric-furnace process, and in some foundry and other metallurgical operations.

Fluorspar is used in considerable quantities in the glass industry, chiefly for the manufacture of opal or opaque and colored glass; as an ingredient in enamels for various purposes; and in the manufacture of cement, in which it is said that the addition of fluorspar to the raw materials permits the lowering of the fusing point, resulting in considerable economy in fuel, as well as an economy in power, because the clinker obtained is fragile and therefore more easily ground.

Fluorspar is the basic material used in the manufacture of hydrofluoric acid. It is also said to be used to facilitate the fusion and contact of ingredients in the manufacture of calcium carbide and cyanamid.

A very small quantity of clear fluorspar crystals is used for optical purposes; fluorspar is useful in correcting the color and spherical abberation errors in lenses, especially for microscopes and small telescopes.

Copies of the Bureau of Mines statistical report on "Fluorspar and Cryolite in 1927," by Hubert W. Davis, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 5 cents.

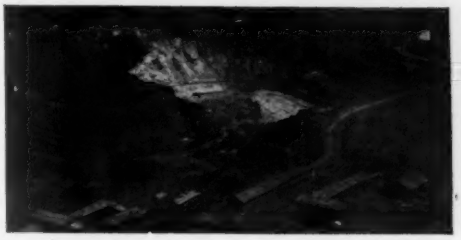
SALES OF LIME IN 1928

The estimated sales of lime by producers in the United States in 1928 amounted to 4,395,000 short tons, valued at $36,600,000, according to estimates furnished by lime manufacturers to the United States Bureau of Mines. This is a decrease of less than 1 percent in quantity and 5 percent in value as compared with sales of 4,414,932 tons, valued at $38,638,413 in 1927.

METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry



TREATMENT *of* COMPLEX ORES *in the* SOUTHWEST*

By H. B. MENARDI †

THE term "complex ore" as used in this paper refers to those ores carrying gold, silver, lead, copper, zinc and sometimes other metals, all intimately associated, and in such combinations that the ores can not be smelted directly.

Any discussion of present-day methods followed in the treatment of these complex ores in the Southwest will at once involve the question of selective flotation either as a direct process for segregating the various valuable constituents of the ore into separate products, which can be marketed profitably, or as a partial treatment used in conjunction with other processes.

Before considering the application of different processes or combinations of various treatments as a whole, it might be well to discuss briefly the latter developments in selective flotation methods and the functions of various reagents now used, more particularly by the comparatively smaller operations.

The outstanding feature of present-day flotation operation is found in nicety of regulation and in precise methods of control. Where reagents were formerly designated in pounds per ton, present-day practice frequently requires the regulation of reagents to one-hundredth of 1 pound per ton. Where a distinction between so-called acid and alkaline circuits by means of various indicators was once sufficient, nowadays a method of control is often used which indicates the precise scale of acidity or alkanity and is more delicate even than titration against normal acid or alkaline solutions.

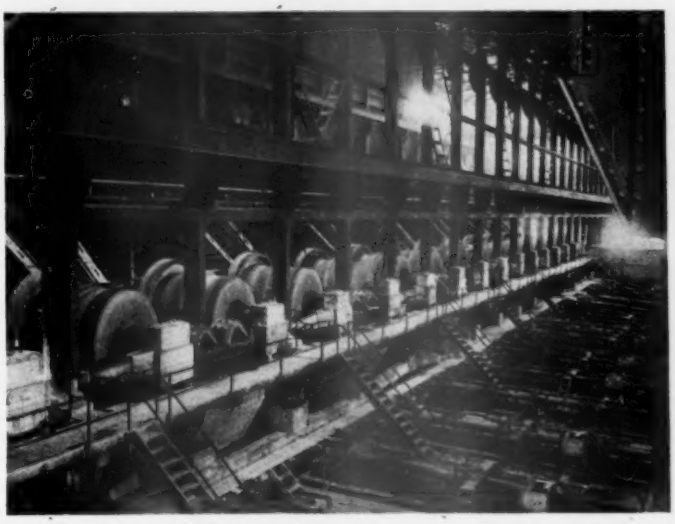
Complex Ores Of Southwest Divided Into Three Classifications—Description Of Methods Used In Recovery Of Each Classification

Present-day practice recognizes the necessity of maintaining uniform dilution and density conditions. And the necessity of "conditioning" a pulp for the purpose of neutralizing or modifying the effects of impurities in the mill water or soluble constituents of the ore itself is recognized in all up-to-date operations.

During recent years a number of organic compounds with special characteristics have been developed. For floating a lead-silver gold product, collectors, such as xanthate, aerofloat, P. E. oil, T-T mixture or thio carbonilid, together with a frother, such as pine oil or cresylic acid, was used. Frequently two or more collectors are used at the same time.

In lead zinc separation, sodium carbonate or bicarbonate cyanide and zinc sulphate are used for depressing the zinc through the lead circuit, and then after the lead has been removed the pulp is reconditioned with lime and copper sulphate and the zinc floated with some combination such as xanthate and pine oil, or P. E. oil and aerofloat. Pyrite is dropped into the tailing by the use of lime, and a small amount of cyanide added to the recleaner cells.

Where the complex ore is more or less oxidized the treatment problem becomes more complicated. Of the oxidized lead compounds the true



The grinding and flotation floors in a large Southwestern concentrator

* Presented to Mining Revival Meeting, Nogales, Ariz.

† Mining and Metallurgical Engineer, Southwestern Engineering Co., Los Angeles.

crystalline carbonates float very readily, while the amorphous varieties containing basic lead-iron sulphate or certain oxides are difficult. An important type of ore in the Southwest and in Mexico carries lead and zinc as sulphides and with predominating silver values in oxidized forms which will not float readily with the lead. With such a type selective flotation may be supplemented by cyanidation for recovery of the silver values where oxidized copper values would cause an excessive consumption of cyanide, the patented "Cyanide Recovery Process," by means of which the active cyanide compounds are regenerated in the solution, might be effective.

In considering the application of these various processes, the complex ores of the Southwest might be divided into three general classifications, as follows:

First: Ores where selective flotation is used for the direct segregation of the valuable minerals into separate concentrates which can be smelted directly.

Second: Ores where two or more products are removed by selective flotation, but where one of these products is segregated for special subsequent treatment, or because it is an interfering element so long as it remains in the original pulp.

Third: Ores where neither selective flotation nor cyanidation could be used alone, profitably, because of poor recovery, low grade concentrates, high consumption of chemicals or for various reasons, but where a combination of the two processes provides for the recovery of a portion of the values in the form of a high-grade concentrate by selective flotation the balance of the recoverable values being returned as bullion from cyanidation.

The following typical examples, taken from actual operations, will illustrate the three general classes.

First classification—direct segregation of different minerals into two or more marketable products:

Head Assay	
2.0 ounces silver	
2.9 percent lead	
12.0 percent zinc	
Lead Concentrate	
Assaying:	Containing:
28 oz. silver	80.0% of the total silver
40.7% lead	82.5% of the total lead
11.4% zinc	
Zinc Concentrate	
Assaying:	Containing:
2.0 oz. silver	80% of the total zinc
1.7% lead	
55.2% zinc	

In this particular plant, grinding is comparatively coarse—2 percent plus 65-mesh.

Pulp dilution is maintained at 20 percent solids. For floating the lead, sodium carbonate, cyanide, zinc sulphate, thiocarbonilid and cresylic acid are added. After the lead has been removed the pulp passes the two conditioning tanks, where copper sulphate, lime, xanthate, aerofloat and pine oil are added for floating the zinc product. Pyrite is dropped out of the zinc concentrate by adding lime and cyanide to the recleaner cells.

Under the second general classification we have one good example in an ore carrying gold, silver, lead, copper, zinc and pyrite. The silver, lead and copper are recovered in one concentrate and the zinc in a second concentrate by flotation. These two products can be sold directly to smelters. The gold in the ore is intimately associated with the pyrite and is recovered by making a pyrite concentrate by flotation and regrinding this product for subsequent treatment and recovery of the gold. Another outstanding example under this classification is found in a straight zinc ore where, in order to get the required grade in the zinc concentrate, it is necessary to first float off a portion of the iron which is by-passed into the tailing. The zinc is then floated and the required grade reached. In this ore the sulphides of zinc and iron are tarnished by partial oxidation. Even at the expense of a considerable sacrifice in recovery it was not possible to reach the required grade of zinc concentrate when following the usual practice for floating zinc and depressing iron in a lime circuit.

The successful treatment which was finally developed illustrates the possibilities of selective flotation for complex ores.

Sodium sulphide is added at the ball mill and part of the iron is taken off on the first rougher. Sodium silicate is added at the same time to assist later flotation of the zinc. After this iron product, which is discarded, is floated off, the pulp is conditioned with copper sulphate and sulphuric acid and the zinc then floated with xanthate, Barrett No. 4 and pine oil. Lime is added to the recleaner cell for depressing iron which is not combined with the zinc marmatite.

An interesting example of the third type of treatment methods is found in an ore, assaying 30 oz. silver, 3 percent lead and 6 percent zinc, which is being successfully handled by a combination of selective flotation and cyanide treatments. Selective flotation alone was not applicable because of poor silver recovery and low ratios of concentration and also because a considerable portion of the silver went into the zinc concentrate. Straight cyanidation was not favored because of excessive cyanide consumption and the loss of return from lead and zinc values. A satisfactory combination of the two methods, however, has been developed and applied with success.

The ore, after being ground to 80-mesh, is given a selective flotation treatment, which produces a high-grade silver-lead concentrate assaying 700 ounces silver and 30 percent lead. This concentrate contains 30 percent of the silver and 80 percent of the lead, together with the copper and other possible cyanides in the original ore. Following flotation the pulp is filtered, repulped with cyanide solution and agitated. This treatment recovers the balance of the silver. The cyanide pulp is then filtered, thoroughly washed, repulped with water and the zinc concentrate floated in the usual manner. By this combined method the total silver recovery exceeds 90 percent. The zinc concentrate produced after cyanidation assays 52 percent zinc and 3 ounces silver. If a zinc concentrate were taken off prior to cyanidation this product would assay 90 ounces silver.

Other illustrations where special methods have been adopted to complex ores could be presented, and, judging from the advances in the art which have been made in the past, it is reasonable to expect that still further advances will be made in the future.

FLOTATION STUDIES AT IDAHO STATION OF BUREAU OF MINES

Coarse flotation studies at the Moscow, Idaho, field office of the Bureau of Mines continue to give highly favorable results. The flow-sheet of the process includes flotation, classification, and tabling in the order mentioned. Flotation takes a coarse feed, preferably not finer than —14 mesh, and recovers the fine and intermediate-size free mineral grains. The classifier makes tailing overflow and the table recovers coarse mineral and middling and makes a coarse tailing.

The process has been tested for its application to two lead ores, one from Missouri and one from the Coeur d'Alenes. The sample tested in each case was the present table classifier feed. In one case, the present practice is to classify the pulp into slimes (fines) and sands—the fines are floated and the sands tabled. The metallurgical result is a gravity tailing of 0.35 percent lead and a flotation tailing of 0.18 percent. Table middlings are reground and table concentrates cleaned. By the new process, comprising flotation, classification, and tabling, a total final tailing of 0.18 percent lead is obtained.

In the case of the other sample, the table feed is customarily classified into several products and each tabled. The classifier overflow is floated. The metallurgical result is a table tailing of 0.9 percent lead and a flotation tailing of 0.18 percent. By the new process a final tailing of 0.25 percent lead was made.

These examples show the effectiveness of this method of attack in the case of these lead ores. It is the same method which has been demonstrated commercially on the copper ores of Michigan.

HOW WE LOOK *for* MINES*

By P. C. BENEDICT †

IT IS my opinion that every mine examination should be started with a dose of salts for the examiner. Intestinal fortitude creates optimism; the engineer should enter upon each project in a spirit of optimism. It also requires optimism for me to try to indicate to this assemblage how to find mines. Fortunately, my subject is "How We Look for Mines," rather than how we find them.

In looking for mines, the United Verde has two methods of attack; the first may be described as the examination of districts; the second method consists of the examination of specific properties which are presented to us.

In the examination of a district, the field geologist may start his work by making a somewhat exhaustive study of the principal properties of the district, of the method of ore occurrence, and of the geological agencies which are responsible for the presence of ore. It may be necessary for him to make a geological map of the district, and, in some instances, to make detailed geological maps of such underground workings as may be accessible. He tries to obtain such reliable information as may be available from operators in the district. He may also find it necessary to use the microscope to identify rocks of economic importance. Sometimes the study of ores in polished and thin sections has yielded information of considerable economic significance. In short, in examining districts it is our aim to gather all the available information which may be useful in making commercial scientific deductions, and applying those deductions in an effort to find new ore bodies.

In our second method of looking for mines—the examination of individual properties which are presented to us, from Canada to Mexico—it is impossible for us to examine all of those presented. It is generally impossible for us to inspect more than one out of every four or five properties brought to our attention.

These properties are brought to our attention by prospectors, owners, promoters, "friends," and occasionally by engineers. Frankly, we are prejudiced

United Verde Has Two Methods Of Looking For Mines, Examination Of Districts, And Examination Of Specific Properties—A Description Of Methods Employed

in favor of the prospector or owner as contrasted with the promoter, the "friend," and, in many instances, the engineer. The reason for this is that the prospector or owner will have first-hand information on his project; this information has been accumulated through long personal contact with the property, which is in sharp contrast with the second-hand, superficial, and too frequently inaccurate information passed on to us by promoters and "friends." I regret that it has been our experience that information submitted to us by men signing "E.M." or "Geologist" after their names is frequently found to be as inaccurate as that submitted by the promoter. It is true, of course, that a complete and well-written engineer's report, giving the actual specific details on which his conclusions are based, commands our respect and attention; he talks our language and we can understand him. Nevertheless, it is our experience that we can frequently obtain the same, or better, specific information from the conscientious prospector. His application for our interest may be scrawled in a handwriting handicapped by rheumatism; in his first communication he generally does not give more than a smattering of the information we require. However, his letter receives exactly the same consideration as is given a typed report which, it is to be regretted, frequently contains no more information than the prospector's letter. It may be necessary for us to exchange several letters with the prospector in order to obtain such specific information as is necessary for us to make our decision regarding the advisability of an examination.

We also correspond with other companies and with reliable engineers regarding the merits of properties presented to us. We refer to the literature. Unfortunately, however, from the commercial point of view such properties as are presented to us are but rarely covered in publications with any degree of thoroughness.

Occasionally we find it advantageous to request the prospector or owner to send us samples. Sometimes, from our previous correspondence, we are able to more or less definitely instruct in just what manner we should like to have the samples taken. The number of men who have complied with our request with considerable care and have submitted us worth-while samples is gratifying. We believe that the prospector who has faith in his property and his claims for his property is not only willing but interested in cooperating with us to this extent. When he is willing to do so, we try to reciprocate in a measure by assaying his samples free of charge and submitting him a copy of the results, regardless of whether or not we take further interest in the prospect.

In some instances, of course, a worthy prospect may have no commercial ore showings, and in such instances we are frequently able to obtain some specific information by having specimens of the cropping, gossan, or wall rocks submitted to us. In one district in the state, one of our engineers made so thorough and instructive study of the mineralization that he is able to identify the type of quartz with which commercial ore is associated. This is possible even though in the particular exposure or specimen the ore type of quartz may be lean, or the uncommercial type enriched so as to locally assay well. We believe that by submitting specimens to this engineer we shall be able to avoid fruitless examination work in this district.

We maintain a file on all properties presented to us. This file has a triple-cross index; first, according to the present and former names of the property; second, according to names of interested parties; and, third, according to geographical location. Hence, when a property is presented to us we require the name, location, and the owner's name, in order that we may correlate previous information with the new. We must maintain a high standard of integrity in order that promoters should be willing to im-

* Presented to Mining Revival Meeting, Nogales, Ariz., November 19-21.

† Field Geologist, United Verde Copper Company, Jerome, Ariz.

part to us the required data. However, we prefer to deal directly with the prospector or owner and, since we are already prejudiced in his favor, as previously mentioned, there is no reason why he should not approach us directly rather than through the medium of a promoter.

We insist on having an accurate description of the location of a property for three reasons; first, in order that the examining engineer may find the property with the least possible trouble; second, in order to identify the property in our files; and, third, even though we have no specific information on the property in question, we may have information on other properties, either adjacent to it or in the same district. This information will assist us both in deciding upon deciding the advisability of making an examination and in a broader knowledge of the district should the examination be undertaken.

In addition to the above information regarding a property presented to us, we also make inquiries concerning roads, water, timber, equipment, and ask for a description of the vein or deposit, a description of the outcrop and development work, as well as a statement of terms under which the property is held. A good assay plan or section is as much appreciated as it is hard to obtain. There are some of these features which, even though unfavorable, would not of themselves justify our neglecting to make an examination.

One of the factors which frequently causes us to omit an otherwise meritorious property from our examination schedule is the terms on which it is presented. It may seem impossible for us to refuse to examine a property which we have never examined because of the terms, and yet we frequently find justification for so doing. If all that the owner claims for his property is true, we can arrive at some sort of an approximation of what its present value might be, or what further amount it might be necessary to spend before we might be able to establish whether the property has any value whatsoever. If the owner's price is entirely out of line with what specific information he is able to give us, or if his terms are such as to be inconsistent with his claims for the property, we generally do not feel justified in even going to the expense of examining an otherwise interesting property. In general, we feel that there are very few mines for sale with sufficient ore in sight, or with sufficient positive ore, to warrant a cash payment before we have been given an opportunity to demonstrate the presence of such ore. We do not mean to be smug or satisfied, but we do not feel that we should pay for the privilege of spending our money to the mutual advantage of the seller as well as the buyer. The necessity of paying a cash sum before development increases the gamble in the same proposition as the cash payment may have to the initial development expenditure. There are doubtlessly cases wherein, had the initial payment been expended in additional development, a deal would have been consummated and the owner would be the possessor of a small amount of cash and a mine which had been dug with unsatisfactory results.

In the case of the owner who has no way of supporting himself during the development period, we have tried to adopt a square and humane attitude. In cases where there is actual need for liberality we have sometimes been willing to give him employment at a salary sufficient to tide him over. In general, however, I wish to emphasize the fact that we are unfavorably disposed towards paying for the privilege of developing a property.

In the elimination of properties not meriting an examination, we frequently find help in certain broad geological generalizations; for instance, we believe we are justified in a prejudice against base metal deposits situated in volcanic rocks and contact metamorphic silicate zones. We have neglected to examine supposed deposits situated in basic volcanic rocks, as well as a platinum deposit in rhyolite. We are not unaware of exceptions to some of these generalizations, nor do we maintain such prejudices as rule of thumb methods, but merely as helps in deciding which properties are most probably deserving of examination. We are certainly most willing to concede first place to specific information indicating the actual or probable occurrence of commercial ore, no matter what prejudices we may maintain as tentative standards.

In general, we have little interest in properties presented to us for which very high grade ores are claimed. It has always been difficult for us to understand why an owner should desire us to develop a property in which the ore is so rich as to be self-developing. However, this is not a rule of thumb with us; it is merely one of our tendencies born of past experience.

In admitting our prejudices, I am merely trying to expose our viewpoint to those of you who may have a property to present. We are only too glad to be honestly and fairly convinced of the merit of a property. It has not been the intention of this talk to indicate how difficult it is to convince us that a property merits examination, but to show you how hard we try to obtain the information that will reasonably justify such inspection.

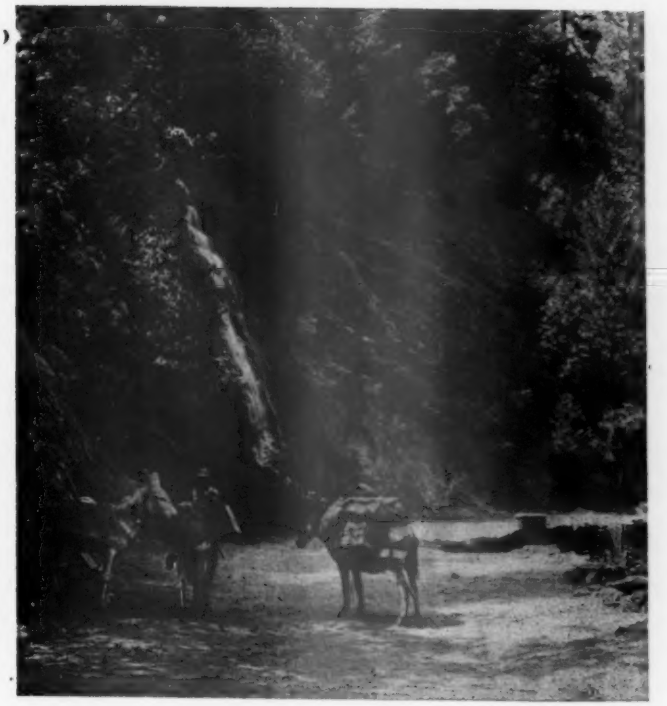
To describe to you our general methods of examination would be but the repetition of our textbooks, with perhaps some additions due to the personal experience of the engineer and information which he has gleaned from his associates. We attempt to check for ourselves all of those factors, a tentative knowledge of which I have mentioned our trying to obtain through correspondence. Further than that, we are able to make structural studies which are frequently of vital importance. The work of Locke, Blanchard, and Boswell on the interpretation of leached outcrops is of great significance to the scout. Their studies are not only important with regard to certain of the base metal deposits but also in certain types of precious metal deposits in which the gold and silver is associated with pyrite, chalcopyrite, or galena, as the case may be.

The field geologist may find the theories of zoning of some concrete commercial assistance. For instance, there is a batholith in the state surrounded by a halo of ore deposits, some of them of the first magnitude. A few miles distant, but in the center of the batholithic mass, are small quartz veins carrying pyrite, chalcopyrite, and a little molybdenite, with coarse sericite or muscovite. Some of these veins contain small shoots which have been leased at a profit, but it seems to me that the general occurrence does not justify an expectancy of profitable deep operations.

There are sometimes regional guides which may be of some service in reconnaissance work. For instance, it is a remarkable fact that the major gold deposits of Nevada and adjacent portions of Arizona have been found so frequently in andesite, or in closely related rocks, such as the dacite at Goldfield. This is particularly conspicuous when contrasted with the histories of the gold camps situated in rhyolite in the same general province.

We attempt to find evidence indicating whether a given rock or a given horizon may or may not be favorable to mineralization. We are not prepared to state that rocks of the same petrologic name or geologic age may be favorable or unfavorable to mineralization over a large area, but we believe in recording these facts, summarizing the information, and, if there are generalizations to be drawn, consider them tentatively until they have withstood the test of time, contention, and the collaborative work of our contemporaries.

I regret to state that we have not discovered the answer to the question, "How far is it between mines?" The aggregate travel mileage of our field force during the past two and one-half years proves that at least it will be something over 150,000 miles between the United Verde and its next mine. However, perhaps more interesting than the distance between mines, or "How We Look for Mines," is the simple fact that we are still looking.



IS The OLD PROSPECTOR NECESSARY?

By W. B. GOHRING *

While The Past Ten Years Have Been Particularly Discouraging For The Prospector, He Is As Essential To Mining Development As He Ever Was —Difficulties Of The Prospector

I DO NOT know who picked that title and picked me to answer the question, but I certainly do know that my answer is "yes." I have spent a good many years out in the hills along this border and I have many friends who have been prospecting in them longer than that. I have intended to spend more years in these hills, and I am afraid I could not, safely, if I answered the question "no."

Aside from consideration of my own personal safety, I do not see how the answer could be anything but "no." I do not believe that there is any mine in this western country that was not discovered by some prospector scouting around the hills, and I do not believe there will be one. Science is doing a lot in developing methods of electrical prospecting, but it is very unlikely that such methods will ever be used for prospecting any field to which attention was not originally directed by some prospector.

I believe it is true that the prospector has a tougher time today, or less chance to "make a stake" than formerly. This is due to various causes. The western country is more thickly settled and mineral showings easier of access. In the old days the prospector had a long tough trip to get anywhere, with his pack saddle, and he got into some pretty inaccessible places, country where very few men had possibly been. He had a better chance of finding something new. Today, with automobile roads everywhere, and Ford cars to go where there are no roads, there is certainly less unexplored country and less chance of finding rich pockets or bonanzas, so called.

Another reason is that if he does find something promising it is more difficult to get the initial financial backing than in the old days. Then if the prospector had something in the nature of a likely small mine he could go into a town where he was known and get a few hundred dollars necessary to sink a shaft or run a tunnel, from almost any of the business men, and if this work showed up well there was usually no trouble getting the money locally for more extensive development and equipment. To me it seems that there is very much less of this, what I call small money, put into mining than formerly. I think it probable that it is because there are more opportunities to spend money today; but I believe most of us who lived in mining camps before the days of automobiles will remember chipping into a pot for some prospect's development. It was done by everyone then, whereas today it is not.

Another reason why a prospector can not get action as readily today is on account of the general change in mining. Mining companies are not as much interested in small rich mines today as they were 20 and 30 years ago. Today they want something big.

You may be interested to know that up to about 1909 all of Arizona copper came from the so-called high grade or direct smelting ores. Today only about 30 percent of the copper comes from such ores. In 1909 the production in Arizona was, roughly, 250,000,000 pounds, and this year and last year it will be around 700,000,000 pounds, all of the increase being from the low grade or milling ores.

The high-grade ores came from relatively small and usually irregular deposits, always with an indefinite or uncertain future. The low grades come in enormous masses, which are outlined at the start so that before production is started they are assured of a life of 20 or 40 years. The last type is much more desirable owing to the stability afforded the company, and no one will deny that the copper production business is much more stable today than it was 20 years ago. It is a stable, big business today, whereas before it was mining, with its hazards always present. For this reason it seems perfectly natural that big mining money, in this region at least, is not so much interested in the prospector who

* Secretary of Arizona Chapter The American Mining Congress. Presented to Mining Revival Meeting, Nogales, Ariz.

brings in a relatively small showing today, however promising for rich ore.

I have been stating some of the reasons why the old prospector may find it harder today to get backing for the average prospect, but this does not at all mean that the old prospector is unnecessary. The old cycle always was and always will be—the prospector finds it, the engineer or geologist passes on it and its possibilities, and the financier finds the money to make it into a producing mine. I can not conceive of any of my many friends among the field engineers and geologists wandering at random through a mountain range, fixing his eye on some distant reddish outcrop, and spending laborious days climbing to it and tracing out its edges for mineral. I can not conceive of any of the millionaires who have become wealthy on mines, and are willing to put some of it back in the ground, spending a month or two with a single-jack and a few pieces of hand steel cutting a trench or sinking shallow shafts in the attempt to find out if the ledge goes down or is merely superficial. These things are for the prospector. He will continue to point out the way to the other two.

The past 10 years have been a particularly discouraging period for the prospector in this region. The big mining companies have been, of necessity, going through a period of retrenchment, owing to their narrow margin of profit on the price received for copper, and have not had any easy surplus to devote to outside development.

The rapid developments in the mining and milling of low-grade ores have also been absorbing recently the attention, energies, and capital of most of the big copper companies. Unquestionably the greatest forward stride in the industry during the period of my mining life has been in the development and refinement of processes for saving the values from low-grade ores of copper, lead, and zinc. It was only two or three years ago that 75 percent and 80 percent recoveries in mills represented good work. Today they are over 90 percent. Do you realize that the saving alone of values in modern flotation plants over old-fashioned gravity methods has rendered available for profitable treatment enough hitherto worthless material to be equivalent to the discovery of half a dozen new mines?

I think this period is almost at an end. It is somewhat parallel to the period of evolution through which the packing industry went a few years ago. When they got through they had learned to save everything but the squeal of the pig. Similarly, the mining industry has been experimenting until there isn't much more to save. They will have to turn their attention to new sources of revenue and go into new fields. With better copper prices they will be freer financially. I do not know where they can go except to follow the prospector into the hills, and I prophecy that in the immediate future there will be much more new exploration in this region than in the immediate past.

I further prophecy that if the same man gets up the program for a mining meeting 10 years from now and will carefully check up to their origin all the successful mining developments that have come into their own during the 10 years, he will not ask me to read a paper on "Is the Old Prospector Necessary?"

EXTRACTION OF POTASH FROM GREENSANDS

An investigation of some of the various processes proposed for the utilization of greensands, of which there are very large deposits along the Atlantic seaboard, is in progress at the Nonmetallic Minerals Station, of the United States Bureau of Mines, at New Brunswick, N. J. A bibliography of the literature of greensands has been completed and will be published in the near future. An economic survey of some of the proposed processes is also in course of preparation.

In the laboratory, experiments have been in progress for about two months on the so-called Charlton-Shreve process, involving the digestion of greensands with slaked lime at 200° C. The results of these experiments may be briefly summarized as follows:

Digestion for two hours of 1 part greensand with 0.9 parts of lime, and 5.0 parts of water at 200° C. and 225 pounds pressure in an autoclave resulted in 55 percent of the potash being rendered soluble. Digestion for four hours rendered soluble 67 percent of the potash. The greensand used contained 6.5 percent potash, and was ground as fine as is possible in a small ball-mill. These results agree reasonably well with those of previous investigators.

CONCENTRATION OF LOW-GRADE PHOSPHATE ORES BY FLOTATION

An investigation of the flotation of low-grade phosphate ores and waste material from the Florida washers has been in progress at the Southern Experiment Station of the United States Bureau of Mines, Tuscaloosa, Ala., for some time. Several reagent combinations that will effect satisfactory separations between the phosphate and the quartz, the main gangue impurity, have been developed. A procedure based upon a preliminary conditioning treatment with sodium sulphide, followed by roughing and cleaning flotation runs with oleic acid and sodium silicate, promises a low reagent cost. This procedure has been applied using the hard waters from the Florida district. In the laboratory, washer rejects from an ore in which the phosphate grains are mainly dark in color and fairly dense have been ground to pass 35 to 40 mesh and then treated in cyclic tests. The water used to pulp the samples has been conserved by settling and de-watering the products of each test, so that the new water added averages less than the weight of ore treated. In tests with raw water the reagent consumption is high but by reuse of the water the reagents necessary to effect satisfactory separations between the phosphate and quartz have been reduced to amounts comparable with the consumption in distilled water. The indicated reagent consumption in pounds per ton of material treated is as follows:

Sodium sulphide (fused, 60 percent commercial)	1.5 -2.0 lbs.
Oleic acid (commercial)	0.7 -1.0 "
Sodium silicate (commercial)	0.15-0.3 "

At present market prices the indicated cost is from 11 to 15 cents, for reagents. Satisfactory separations have been obtained with recoveries of from 85 to 90 percent of the phosphate in concentrates that are commercial in grade with a single cleaning operation.

ZINC IN CYANIDATION

In the usual cyanidation with zinc dust as the precipitant, the accumulation of zinc in the mill solution is very slow, and often counterbalanced by its precipitation through contact with fresh ore and lime together with the continual removal of waste solution with the tailing.

If the ore contains soluble zinc minerals or soluble copper minerals and this copper is precipitated with zinc dust the accumulation of zinc in the mill solution is quite rapid and plainly shows by lowered extraction of the precious metals. The zinc dust is also slowly dissolved in cyanide solution.

Experiments conducted by the Rare and Precious Metals Experiment Station of the United States Bureau of Mines, Reno, Nev., have shown that the double sodium-zinc cyanide that is formed is a weak solvent for precious metals from their ore, due to the slow liberation of free cyanide. Different ores also release varying small amounts of free cyanide. Lime partially and strong alkali completely free the cyanide from sodium-zinc cyanide. However, the zinc still remaining in the solutions adversely affects the dissolution of precious metals. The zinc must be removed from the mill solution to obtain maximum extraction.

MINERAL PRODUCTION *of the* UNITED STATES *in* 1928*

THE total value of mineral production in the United States in 1928 was approximately $5,400,000,000, as estimated by the United States Bureau of Mines. This is a decrease of approximately 2 percent of the total value of mineral products in 1927 and is due almost entirely to a decrease in the total value of mineral fuels. Of these, the quantity and value of coal decreased; the quantity of petroleum produced changed little, but the value decreased and the quantity and value of natural gas and natural gasoline increased as compared with 1927. The total value of metallic products shows an increase due to increase in quantity and unit value of copper and an increase in the quantity of iron produced. Decreases were shown for gold, silver, lead, and zinc. The total value of nonmetallic mineral products shows approximately no change. Decreases for some of these products were offset by increases for others.

The following figures give the estimated total value of metallic mineral products and nonmetallic mineral products other than fuels and of mineral fuels produced in the United States in 1928.

ESTIMATED VALUE OF MINERAL PRODUCTS OF THE UNITED STATES, 1928

Metallic	$1,260,000,000
Nonmetallic (other than fuels)	1,240,000,000
Mineral fuels	2,900,000,000
Total	$5,400,000,000

These estimates are subject to revision and replacement by precise figures as soon as the Bureau of Mines can complete the canvass of mineral industries just begun to obtain accurate statistics for the year 1928. In this canvass the bureau is sending to every mining, quarrying, and well-operating company an inquiry soliciting a report on the output of each mineral commodity by each producing establishment. Early success in this undertaking is dependent upon the continuation of the prompt and cordial response on the part of the mining companies which has been the basis of success in this statistical endeavor through many years.

* From statistics compiled by the Alaskan Branch of the Geological Survey, and for the Bureau of Mines by C. N. Gerry, V. C. Heikes, Charles W. Henderson and J. M. Hill.

Arizona

THE value of the gold, silver, copper, lead, and zinc produced by mines in Arizona in 1928 was $116,462,000, an increase from $98,790,957 in 1927, according to the United States Bureau of Mines. The increase in copper was marked and there was a slight increase in silver, but the gold, lead, and zinc decreased as compared with the totals of 1927. The large producers of copper responded to the increased price of the metal, especially during the last six months of the year, but the decrease in gold from Mohave County was pronounced. The prices of lead and zinc, less than those of 1927, did not encourage the operators to market lead and zinc products. Unusual activity was shown in building mills, especially the construction of flotation plants for copper ore and lead-zinc ore.

Dividends amounting to $16,376,937 were reported paid in 1928 by the following Arizona mining companies: Calumet & Arizona, United Verde, New Cornelia, United Verde Extension, Magma, Miami, and Arizona Commercial. Dividends of $3,500,000 were also paid, it is reported, by the Phelps Dodge Corporation. Profits from the Ray mine are included in dividends of $7,384,846 reported paid by the Nevada Consolidated Copper Co., operating properties in Nevada, Arizona, and New Mexico.

The gold output decreased from $4,144,591 in 1927 to about $3,930,000 in 1928 in spite of the impetus to the production of gold recovered from copper bullion.

Decided increases were made in the production of gold from the Calumet & Arizona, United Verde, and Magma mines, but decreases from the Old Dominion, New Cornelia, United Verde Extension, and Shattuck Denn properties were recorded. The output of the Katherine mine in the Union Pass district, Mohave County, was only about half that of 1927, and gold from the San Francisco (Oatman) district was decidedly less. Nine companies produced more than $100,000 worth of gold, each, in 1928—United Verde, Copper Queen, Calumet & Arizona, New Cornelia, Magma, United Verde Extension, Katherine, the Morenci branch of the Phelps Dodge Corporation, and the Tom Reed properties. Considerable gold was also produced from the Shattuck Denn property near Bisbee, the Old Dominion mine at Globe, the Bunker Hill group at Tombstone, the MacNeill mine, a producer of lead ore in Maricopa County, and the Commonwealth properties. Several new mills designed to treat gold ore were completed at Oatman, Mohave County, and in Yavapai County.

The silver output increased from 6,847,680 ounces in 1927 to about 6,943,000 ounces in 1928, and the value from $3,882,635 to about $4,062,000. The output of silver from Arizona mines has gradually increased in recent years and the state ranked fourth in the production of this metal. The United Verde mine continued to exceed all other mines in the state as the largest silver producer. It has greatly increased its output since the large new flotation mill started operating early in 1927. Other large producers were the Calumet & Arizona, Magma, Copper Queen, United Verde Extension, New Cornelia, Bunker Hill, Morenci Branch of the Phelps Dodge Corporation, Shattuck Denn, and Old Dominion mines. The decreased output of the Shattuck Denn, Copper Queen, Old Dominion, United Verde Extension, Iron Cap, and other properties did not prevent the larger producers from upholding the total silver output of the state.

The copper output increased from 682,190,547 pounds in 1927 to about 736,282,000 pounds in 1928, and the value from $89,366,962 to about $107,497,000. The output of the Calumet & Arizona, United Verde, Copper Queen, Ray, New Cornelia, United Verde Extension, Magma, and Shattuck Denn mines was decidedly increased. The output of copper from ore leached at the Inspiration, United Verde, and New Cornelia properties was also greater. As in 1927, eight copper smelting plants within

The Ray, Arizona, plant of the Nevada Consolidated Copper Company, in the vicinity of No. 1 shaft

the state were active throughout the year, but the plant at Humboldt was idle. Despite favorable conditions in 1928 the production of copper from the Morenci, Old Dominion, Miami, Arizona Commercial, and Inspiration mines was less than that of 1927. The largest copper producers in 1928 were the United Verde, Copper Queen, Inspiration, New Cornelia, Nevada Consolidated (Ray mine), Morenci, Calumet & Arizona, Miami, United Verde Extension, Magma, and Old Dominion mines. Other mines that produced more than 1,000,000 pounds of copper each were the Shattuck Denn, Arizona Commercial, El Tiro, Christmas, and De Soto properties. A notable increase in copper was made at the Copper Queen (Sacramento Hill), United Verde, and New Cornelia properties as a result of the work at their large flotation mills. A new 300-ton mill was completed at Jerome for the Verde Central mine, and it is expected that the property will be a large producer in 1929.

The lead production in Arizona decreased from 19,865,961 pounds in 1927 to about 14,767,000 pounds in 1928, and the value from $1,251,556 to about $901,000. The Copper Queen mine at Bisbee took first place as the largest lead producer in Arizona, and it was followed by the MacNeill mine of the Tonopah Belmont Development Co. in Maricopa County, and the Montana mine in Santa Cruz County. Other large producers of lead were the Shattuck Denn, Seventy-nine, Calumet & Arizona, New Dominion, Martinez, and Bunker Hill mines. The Montana mine at Ruby became a large producer of both lead and zinc in September, after a 250-ton flotation mill was completed by the Montana Mines Operations Co. The new lead smelter of the Phelps Dodge Corporation at Douglas was operated throughout the year, treating much lead ore and concentrate that formerly went to El Paso, Tex.

The output of zinc recovered chiefly from mines in Santa Cruz County during the last quarter of the year decreased from 2,268,960 pounds in 1927 to about 1,200,000 pounds in 1928, and the value from $145,213 to about $72,000. The large decrease in zinc was due to the curtailment of lead-zinc shipments by the Calumet & Arizona Mining Co. The Arizona Hillside Development Co. was idle and few zinc products were shipped from Mohave County. The new flotation plant at the Montana mine at Ruby was worked regularly for four months on lead-zinc ore. Lead concentrate and zinc concentrate were shipped to Texas for treatment.

Alaska

MINES in Alaska are estimated to have produced minerals to the value of $14,128,000 in 1928, as against $14,404,000 in 1927. The total value of the mineral output of Alaska since 1880 is nearly $600,000,000. The source of this mineral wealth is shown in the table above.

VALUE OF MINERAL OUTPUT OF ALASKA IN 1928 AND 1927

	1928 (est.)	1927
Gold	$6,775,000	$5,927,000
Copper	6,100,000	7,250,000
Silver	273,000	356,000
Coal	624,000	548,000
Other minerals (lead, petroleum, marble, tin, platinum, etc.)	356,000	323,000
	$14,128,000	$14,404,000

The total production of gold from Alaskan mines in 1928 is estimated at $6,775,000, a noteworthy increase over the production of the preceding year. The greatest increase came from lode mines, so that the ratio of the value of the gold produced by them to that of the gold produced by the placers seems to have been about 52.7 to 47.3. This is a rather significant change, because in 1927 the corresponding ratio was about 50-50, in 1926 it was about 44 to 56, and for the entire period that gold mining has been in progress in the territory it has been 33 to 67.

The increase in the production of gold from the lode mines is attributable mostly to the greater output from properties of the Alaska Juneau Gold Mining Co. in southeastern Alaska. The quantity of ore mined by this company appears to have been somewhat less than in the preceding year, but its gold tenor was much higher.

The increase in production of gold from placer mines is attributable in most part to the greater output from the properties of the Fairbanks Exploration Co., in the Fairbanks district, which early in 1928 placed two of its large dredges in operation in Goldstream Creek and the Chatanika River, and before the end of that season had finished a smaller dredge on upper Goldstream Creek and had begun mining with it. The beginning of production from this large project has not only resulted in greatly increasing the amount of gold mined in the district but, what is perhaps even more significant, gives promise of a greater output in the succeeding years. So far as has been reported, no other new dredges were constructed in Alaska during 1928, but several that were constructed in 1927 and operated only a short time during that year were running throughout 1928. Approximately 64 percent of the placer gold that was recovered in 1928 was mined by dredges.

The value of the copper produced from Alaskan mines in 1928 is estimated to have been $6,100,000, a decrease of about $1,150,000 over the value of the copper produced by these mines in 1927. In 1928, as in former years, practically all of the copper came from two mines near Kennecott, in the Copper River region, and from one mine on Latouche Island, in the Prince William Sound region. These mines alone have yielded copper worth $200,000,000 in the 18 years or so that they have been actively developed.

Most of the silver produced in Alaska during recent years has been recovered from the copper ores; in fact, during 1927, the latest year for which complete reports are available, over three-quarters of the silver came from that source. With the great reduction in the output of copper ore in 1928 the quantity of silver naturally shows a corresponding decrease. The greater output of gold from both lodes and placers resulted in a slight increase in the amount of silver that is associated with the gold obtained from them.

The production of coal from Alaskan mines was greater in 1928 than in 1927; in fact, the preliminary estimates indicate that more coal was produced in 1928 than in any earlier year. As usual, the greater part of the production came from the Matanuska and Healy River fields. The principal producing mines in the Matanuska fields were those of the Evan Jones Coal Co. and the Premier Coal Mining Co., and in the Healy River Valley the Suntrana mine of the Healy River Coal Corporation.

All the petroleum produced in Alaska in 1928 continued to come from the wells of the Chilkat Oil Co., near Katalla, where, in addition to the oil wells, the company operates a small refinery. The gasoline and distillate produced from this petroleum are much in demand in the local market, as they are said to be of better quality than the usual commercial brands.

In addition to the mineral products already mentioned, Alaska also produced during 1928 some lead, marble, limestone, tin, and platinum. The aggregate value of the output of these minerals, with that of petroleum, was $356,000. Most of the lead came as a by-product from the gold ores of the Alaska Juneau mine, and the increased production of those ores resulted in the recovery of a greater amount of lead also. An increasing amount of lead is also recovered from the silver-lead ores of the Hyder district. The output of marble in 1928 came as heretofore entirely from the quarries of the Vermont Marble Co., on Prince of Wales Island, in southeastern Alaska.

California

THE estimated value of the gold, silver, copper, and lead produced in California in 1928 was $15,470,000, according to an estimate of the Bureau of Mines. As compared with 1927, this is a decrease of $1,361,000, or 8 percent, but in this decline there is a value of $516,008 for zinc produced in 1927. No zinc mines were operated in 1928. All metals showed decreases in the quantities produced and in only one instance did the value of the metals increase, namely, copper, due to increase in the price of the metal as compared with 1927.

The gold production in 1928 is estimated at 524,300 fine ounces, valued at $10,838,000, as compared with 564,586 ounces, valued at $11,671,018, in 1927, a decrease of 7 percent from 1927. The yield of gold from dredges decreased, but new operations in the dredging fields helped to prevent a larger decline. The production of gold from lode mines was maintained at a favorable rate, as compared with 1927, due to intensive development at the larger gold lode mines.

The silver yield in 1928 is estimated at 1,504,000 fine ounces, valued at $880,000, as compared with 1,620,242 ounces, valued at $918,677, in 1927, a decrease of 7 percent in quantity and of 4 percent in value. The California Rand Silver (Inc.) and the Mono Mining Co. were the only large producers of silver ore in the state. The Engels and Walker mines in Plumas County were large producers of silver from copper ores, but the silver yield from lead-silver properties in Inyo and San Bernardino Counties was not as large as in 1927.

The production of copper in 1928 is estimated at 25,000,000 pounds, valued at $3,650,000, as compared with 27,133,008 pounds, valued at $3,554,424, in 1927, which is a decrease of 8 percent in quantity and an increase of 3 percent in value. Because of favorable conditions sur-

rounding the copper industry the last half of the year the principal copper companies increased their yield during the latter months and planned for larger output in 1929. However, the Balaklala was closed the last half of the year, and the Afterthought, Bully Hill, and Calaveras remained idle since closing in 1927.

The output of lead in 1928 is estimated at 1,676,000 pounds, valued at $102,000, as compared with 2,718,014 pounds, valued at $171,235, in 1927, a decrease of 38 percent in quantity and 40 percent in value. Many of the lead properties were idle, due to continued low price of lead, and small shippers in Inyo and San Bernardino Counties were not as many as in previous years. However, the Butte lead mine in the Ubehebe Mountains, near the California-Nevada line, in Inyo County, made a large recovery and was the chief producer of lead in the state.

Portland Gold Mining Properties at Victor, Colo.

Colorado

THE estimated output of gold, silver, copper, lead, and zinc from Colorado mines in 1928 in terms of recovered and estimated recoverable metal was 253,644 fine ounces of gold, 4,131,465 ounces of silver, 8,119,000 pounds of copper, 54,036,000 pounds of lead, and 65,203,000 pounds of zinc. These figures are to be compared with 255,377.33 fine ounces of gold, 3,784,605 ounces of silver, 5,670,581 pounds of copper, 66,772,557 pounds of lead, and 71,729,000 pounds of zinc in 1927. Compared with 1927 figures, gold shows a decrease of $35,831, silver an increase of 346,860 ounces, copper an increase of 2,448,419 pounds, lead a decrease of 12,736,557 pounds, and zinc a decrease of 6,526,000 pounds. The gross estimated value of the output of metals in Colorado in 1928 is gold $5,243,287, silver $2,416,907, copper $1,185,374, lead $3,296,196, zinc $3,912,180, or a total of $16,053,944, compared with $16,965,162 in 1927.

The Cripple Creek district in 1928 produced $3,098,212 in gold, as compared with $3,307,505 in 1927. This decrease is explained by the fact that the grade of ore mined was very much lower in average content, though the tonnage was greater. The Cresson mine, in particular, produced nearly 30,00 tons of ore more than in 1927, but the grade of ore in 1928 averaged about $3.80 a ton less than in 1927. The Portland-Independent mill, at Victor, was closed down December 1, 1928. Production was steady from the various properties of the United Gold Mines Co. Other producing properties were the Blue Bird, Dante, Elkton, El Paso, Empire Lee, Forest Queen, Gold Pinnacle, Granite, Index, McKinney, Midget, Queen, and Stratton Lease.

At Leadville only one furnace was in blast at the A. V. smelter. The Colorado Zinc-Lead Co.'s selective flotation mill was operated continuously with a product of lead and zinc concentrate. The lead-zinc-silver sulphide ore treated at this mill came chiefly from the mines of the Leadville Deep Mines Co. Lead-silver and iron-silver sulphide ores were also shipped by the Leadville Deep Mines Co. to the A. V. smelter and zinc-lead sulphide ore to the Ozark zinc-lead pigment plant at Coffeyville, Kans. Zinc-lead sulphide and other ores were shipped by the Evans-Wallower Co. from the Henriett-Maid of Erin. Lessees on the Ibex and Golden Eagle mines continued to ship pyritic and siliceous gold ores to the A. V. smelter and to the Golden Cycle mill, and occasionally specimen gold to the Denver Mint. Lessees on properties reached through the Yak Tunnel also mined sulphide and oxidized ores. In all, about 25 mines in the Leadville district in 1928 yielded $196,589 in gold, 495,660 ounces of silver, 270,000 pounds of copper, 10,947,000 pounds of lead, and 28,638,000 pounds of zinc in 1928, which indicates an increase for all metals except gold and lead, and a total calculated gross value for the five metals of $2,912,017, an increase of $37,901 over 1927. Manganiferous iron ore totaling 18,500 long tons was shipped in 1928.

At Climax, on Fremont Pass, the Climax Molybdenum Co.'s flotation mill was operated continuously, gradually increasing from 25,000 tons a month in January to 30,000 tons a month in December.

San Juan County's production of $3,567,976 was the largest single county output. The Sunnyside selective flotation mill, at Eureka, was operated continuously, its tonnage at the beginning of the year being 800 tons a day and 1,000 tons a day at the end. Development work on the Mayflower group of the Shenandoah-Dives-North Star-Mayflower enterprise, opened sufficient ore to send to the Iowa-Tiger gravity concentration mill, and later to warrant the remodeling of this mill, which included the addition of flotation machines. The product from the Mayflower ore was gold-copper-silver concentrate. The Lackawanna new 50-ton flotation mill was set in operation in November. There were also several development operations in the county.

The International selective flotation mill, at Rico, was closed in August, 1928, but production of lead-zinc-iron-silver ore continued throughout the year, the crude ore thereafter being shipped to the Midvale, Utah, selective flotation mill. The Rawley 325-ton flotation mill, at Bonanza, Saguache County, was operated continuously in 1928. With the increase in the price of copper, attention was directed to the copper constituent of the Rawley vein, with a resultant increase of copper output and less lead than in 1927, and a gross calculated value for the county of gold, silver, copper, and lead of $1,369,044, as compared with $1,321,640 in 1927. The production of high grade gold ore, continued in 1928 from the Little Annie mine at Summitville, Rio Grande County. The production was respectively $105,799, $133,530, and $221,147 in 1926, 1927, and 1928.

San Miguel County, with the Tomboy mine and mill idle since February, 1927, the Black Bear and San Bernardo idle in 1928, and the Smuggler Union mine and mill at reduced capacity since the fire at the Pennsylvania adit in November, 1927, yielded gold, silver, copper, and lead in 1928 with a gross value of $1,370,797, as compared with $2,118,333 in 1927. The Carbonero mill, at Ophir, and the Butterfly-Terrible new mill, at Ophir, were operated in 1928. La Plata County's yield of gold, silver, and lead had a gross value in 1928 of $64,703, as compared with gold and silver in 1927 valued at $28,156. The producing mines in La Plata County were the May Day and the Gold King. Creede, Mineral County, produced 188,461 ounces of silver in 1928, as compared with 214,850 ounces in 1927.

Production at the Camp Bird lessees' amalgamation-concentration mill, in Imogene Basin, of gold ore from the Jonathan mine, at Ouray, and of copper-silver-gold ore at the San Antonio mine, at Red Mountain, increased Ouray County's gold output from $27,106 in 1927 to $214,987 in 1928 and the county total from $107,559 to $323,981. Development work was done at the Hidden Treasure mine.

Shipments of zinc-lead-silver-iron sulphide ore from the Akron mine, Whitepine, Gunnison County, was resumed in August, 1928, and continued throughout the rest of the year. The Carter amalgamation mill at Ohio was operated for a period, and lead-silver ore was shipped from the Star-Independent mine, on Italian Mountain.

Shipments of limey lead-silver ore from Aspen were dependent on the A. V. smelter's needs, and were therefore less than in 1927. Pitkin County produced 89,670 ounces of silver and 1,495,000 pounds of lead in 1928, as compared with 152,328 ounces of silver, and 2,406,888 pounds of lead in 1927. At Rifle, Garfield County, the 140-ton roasting and leaching plant of the United States Vanadium Corporation was operated stead-

Gen, Idaho, concentrator of the Hecla Mining Co.

ily. At Gilman, Eagle County, all shipments of zinc-lead-silver-iron ore from the Empire Zinc Co.'s mine to the company's magnetic separation plant at Canon City, ceased October, 1927, and none of this class of ore was shipped in 1928, pending perfection of plans for a mill at Belden, which resulted in July in the beginning of excavation for an underground flotation mill to be ready for operation May 1, 1929. Throughout 1928, iron-silver-gold sulphide ore and copper-silver-gold sulphide smelting ore were shipped to the Murray and Garfield plants, Utah. The Canon City magnetic separation plant was closed down, but the Empire Zinc Co.'s oxide plant, also at Canon City, was operated during 1928 on zinc sulphide concentrates from the company's flotation mill, at Hanover, N. Mex.

At Breckenridge, the Wellington (new in 1927 but closed November, 1927) selective flotation mill was set in operation in July and continued throughout the rest of the year to yield zinc and lead concentrates. The Blue River dredge was operated until October. Park County's gold production increased from $39,719 in 1927 to $283,142 in 1928, owing to the completion of the 500-foot ventilation and operating raise at the London mine in July and the steady shipment thereafter of gold ore to Leadville and to Colorado Springs.

Resumption during the summer of the milling of dump ores at the East Butte flotation mill, at Silver Plume, and continuation until November 30, added greatly to Clear Creek County's silver production. The Gold Dirt mill, at Empire, yielded gold concentrate. The mill at the mouth of the Argo adit was remodeled and operated on ores from the Concrete, Ophir, and Phoenix mines, Gilpin County, resulting in an increased production for that county. Production of gold-silver-lead concentrate from the Boulder County mill, at Cardinal, and of gold bullion from the Wood Mountain mill, at Sugar Loaf, added to small lots from other districts in Boulder County, resulted in a small increase in total production. The mill of the Terrible mine, at Ilse, Custer County, was idle all the year, but development work was done until fire destroyed the hoist, compressor, and shaft house, in November, 1928.

Idaho

THE estimated value of the gold, silver, copper, lead, and zinc produced from ore mined in Idaho in 1928, according to estimates of the Bureau of Mines, was about $27,231,000, as compared with $28,104,413 in 1927. The output of gold increased considerably and there was also an increase in the output of zinc, but silver, copper, and lead decreased slightly. The event of the year was the making of exceptionally pure zinc at the electrolytic zinc plant completed at Kellogg. Marked progress was made in the construction and the improvement of flotation milling plants.

According to published reports, mining companies paid dividends amounting to approximately $4,682,375, compared with $5,907,317 paid in 1927. These were paid chiefly by the Bunker Hill & Sullivan, Federal, and Hecla companies. The Sunshine Mining Co. and the Sidney Mining Co. were also contributors.

The mine output of gold in 1928 was valued at about $410,000 as compared with $316,603 in 1927. The increase in the output of gold from the Idawa property near Centerville was notable, and the mine became the largest producer of gold in the state. The South Park Dredging Co. at Featherville, the largest producer of gold in Idaho in 1927, increased its output in 1928, but dredge operations ceased in June. .The Gold Dredging & Power Corporation at Centerville was the third largest producer of gold in Idaho in 1928. Considerable gold was also produced by the Mackay Metals at Mackay, the Boise Placer Co. at Idaho City, and the Lincoln mine at Pearl. The Gold Hill & Iowa mine at Quartzburg, formerly the leading gold producer of Idaho, was unwatered by the Talache Mines (Inc.). Considerable gold ore of good grade was opened on the 700-ft. level, and the property was being equipped with a new hoist and flotation plant late in the year.

The output of silver decreased slightly from 8,901,409 ounces in 1927 to about 8,811,000 ounces in 1928, but the value increased from $5,047,099 to about $5,154,000, on account of an increase in the average price of silver. Despite this slight increase in price, silver recovered from lead ore and lead-zinc ore was less than that of 1927. In the Coeur d'Alene district, which produced at least 8,300,000 ounces of silver, about 75 percent of the product was recovered from the ores of the four largest producers, the Hecla, Morning, Bunker Hill & Sullivan, and Sunshine mines. The Gold Hunter, Tamarack & Custer, Strattons, and Crescent mines were also large producers, and the Page, Triumph, Sherman, Galena, and Caledonia properties followed. The Sunshine property, east of Kellogg, upheld its remarkable record of 1927; the flotation plant was worked regularly, producing a copper-lead concentrate, several shipments of which averaged as high as 800 ounces of silver to the ton. Considerable silver was recovered from mines that have become producers in recent years, such as the Triumph (Blaine County), Whitedelf, Galena, Wilbert, Jack Waite, Page, and Black Hawk properties. The Crescent mine, near Kellogg, was again an important producer of silver after the mill, which was burned in 1927, was rebuilt. The Caledonia mine, although practically exhausted, continued to supply a good production of silver.

The output of copper decreased from 2,173,163 pounds in 1927 to about 2,117,000 pounds in 1928, but the value increased from $284,684 to about $309,000, as the average price of the metal increased. The Mackay Metals, formerly the Idaho Metals Co., was the largest producer of copper in Idaho in 1928, although it did not begin shipments of copper ore and concentrate until August. Other producers of copper were the Hecla at Burke, Winder-Stillman (Pope Shenon) in Lemhi County, and the Sunshine and Crescent properties east of Kellogg. Only an occasional shipment was made from the Harmony property near Baker.

The output of lead decreased from 302,038,423 pounds in 1927 to about 290,753,000 pounds in 1928, and the value from $19,028,421 to about $17,736,000, as a result of the decline in the average price of the metal. The Bunker Hill & Sullivan, Morning, and Hecla mines were as usual the three largest producers. The Golconda Lead Mines Co. completed its 200-ton flotation plant in July and started regular shipments of both lead concentrate and zinc concentrate in August. The company made a large production of lead, zinc, and silver during the last four months of the year. The three leading producers of lead were followed by the Page, Tamarack & Custer, Gold Hunter, Strattons, Jack Waite, Galena, Sidney, Sherman, Golconda, Triumph, Wilbert, Hayes, Black Hawk, United Idaho, and Livingston properties. Considerable lead was also recovered from the Bunker Hill tailing dump near Kellogg. New mills were erected at the Cedar Creek, Lookout, Whitedelf, Dickens, and Hall-Interstate properties.

The zinc recovered from ore and con-

centrate increased from 53,556,345 pounds in 1927 to about 60,360,000 pounds in 1928, and the value from $3,427,606 to about $3,622,000, although the average price was slightly less than that of 1927. No shipments were made from the Douglas or Highland-Surprise mines. Most of the zinc output was recovered by roasting and leaching at Great Falls and Anaconda, Mont. About 5,000 tons of high-grade zinc concentrate was shipped monthly from the Coeur d'Alene region. The Morning mine produced more zinc than all the other mines combined. Next in order were the Sidney, Tamarack & Custer, Triumph, Frisco, Page, Golconda, Humming Bird, Livingston, Bunker Hill & Sullivan, and Star mines. Considerable zinc was also recovered from old tailings deposited in Canyon Creek northeast of Wallace. In June, the Livingston Mines Corporation, operating south of Mackay, made a separate zinc product as well as a lead concentrate. Both products were shipped to Midvale, Utah, either for smelting or remilling. The new electrolytic zinc plant of the Sullivan Mining Co. near Kellogg was completed and operated late in 1928 on zinc concentrate previously stored. In anticipation of this interesting event the Star mine, east of Wallace, made no regular shipments of lead-zinc ore until November. A large output of lead concentrate and zinc concentrate was shipped to Montana, from March to December, from the Hercules custom flotation plant at Wallace, which treated lead-zinc ore and lead ore chiefly from the Strattons, Ambergris, Tamarack & Custer, Sherman, and Humming Bird mines.

Anaconda Hill, Butte, Mont.

Montana

THE value of gold, silver, copper, lead, and zinc produced from Montana mines in 1928, according to estimates made by the Bureau of Mines, was $56,055,000, an increase from $49,265,925 in 1927. The improvement in the market for copper the last six months of 1928 was reflected in the increased output of the Anaconda Copper Mining Co. and other mines at Butte, resulting in a large increase in the production of copper and also in the total value of the metal output of the state. There was also an increase in the output of gold and zinc, but the totals for silver and lead were less than those of 1927.

The Anaconda Copper Mining Co. and the Butte & Superior Mining Co., according to published statements, paid dividends amounting to $11,080,396 in 1928, but part of the Anaconda dividends are paid from profits of subsidiaries in other states.

The value of the gold output increased from $1,106,796 in 1927 to about $1,296,000 in 1928. The largest gold producers in the state were the Anaconda, Liberty Montana, Spring Hill, New Gould, St. Louis, Butte & Superior, Butte Copper & Zinc, and Piegon-Gloster properties. There was a large increase in gold from copper ores, corresponding with the increase in copper, and there was also a large increase in gold from several gold mines. The new cyanidation plant of the Montana-Idaho Mines Corporation started milling ore from the Spring Hill mine in February and the property became the third largest gold producer in Montana in 1928. The New Gould property near Wilborn also increased its output of gold from bullion and concentrate. The Liberty Montana Mines Co. operated its mine and mill near Jefferson Island the entire year, making an important production of copper concentrate chiefly valuable for its gold content. Gold recovered from the ore of the Drumlummon mine at Marysville, a large gold producer in recent years, was decidedly decreased.

The mine output of silver decreased from 11,200,077 ounces in 1927 to about 10,726,000 ounces in 1928, and the value from $6,350,444 to about $6,275,000. In general, the output of silver from the mines at Butte was slightly less than that of 1927, as shown in the statements of the Butte & Superior, East Butte, North Butte, and Moulton mines. However, a good increase was shown in silver recovered from the Elm Orlu, Emma, Ardsley Butte, and Otisco mines at Butte. As usual, the Anaconda Copper Mining Co. surpassed all other mining companies in Montana in the production of silver, and the Butte & Superior property was second. Next in order were the Elm Orlu, Butte Copper & Zinc, East Butte, and Poser properties at Butte, the Silver Dyke mine at Neihart, and the Ardsley Butte property at Butte. Considerable silver was recovered by flotation from the Granite Bimetallic tailings and from lead-zinc ore of the Silver Prince mine, both at Philipsburg.

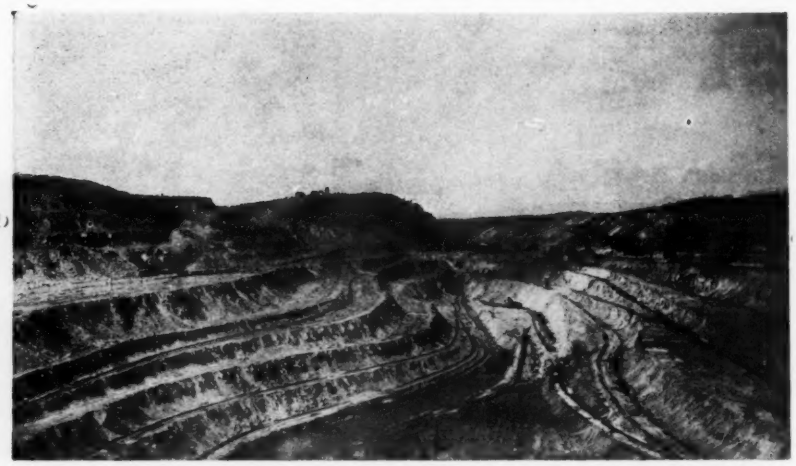
The copper output increased from 223,492,639 pounds in 1927 to about 248,571,000 pounds in 1928, and the value from $29,277,536 to about $36,291,000. The increase of about 11 percent in the output of copper in Montana was due chiefly to the steady improvement in the price of copper the last half of the year. The Anaconda Copper Mining Co., as in the past, produced most of the state's copper from its mines at Butte. The East Butte property at Butte was next in copper output, but the North Butte mine, formerly a large producer, was idle. Other large copper producers were the East Butte, Anselmo, Butte & Superior, and Elm Orlu mines at Butte, and the Silver Dyke property at Neihart. Aside from the output of the Silver Dyke, Liberty Montana, and small mines, the entire copper output was mined at Butte and milled or smelted at Anaconda.

The production of lead decreased from 35,898,315 pounds, valued at $2,261,594, in 1927 to about 32,662,000 pounds, valued at about $1,993,000, in 1928. The chief producers of lead were the Butte Copper & Zinc, Butte & Superior, Poser, and Elm Orlu properties at Butte, the Silver Dyke mine at Neihart, and the Butte Copper Consolidated property at Radersburg; each of these produced more than 1,000,000 pounds. Other producers were the Otisco, Commonwealth, Anaconda, and Galt mines. Considerable lead-zinc ore from the Queen mine at Neihart was treated in the Timber Butte mill at Butte, and similar ore from the Silver Prince and Trout mines at Philipsburg produced much lead. A new mill was completed for the Block P. Mine in Judith Basin County, controlled by the St. Joseph Lead Co. The lead smelter at East Helena was regularly operated, but shipments of lead bullion were less than in 1927.

The output of zinc recovered from ore mined in Montana increased from 160,461,803 pounds in 1927 to about 170,000,000 pounds in 1928, but the value decreased from $10,269,555 to about $10,200,000, on account of the decline in the average price of zinc from 6.4 cents a pound to 6 cents a pound. The electrolytic zinc plant near Great Falls was operated continuously, treating concentrate from Anaconda and Butte and custom material chiefly from Idaho and Utah. The new electrolytic plant at Anaconda was completed and operated from March to the end of the year, making more than 4,000 tons of slab zinc a month. Nearly 85 percent of the total output of zinc was produced from four properties at Butte. The large producers of zinc at Butte were the Butte & Superior, Elm Orlu, Butte Copper & Zinc, Poser, Otisco, and Anaconda properties. Good increases were made at the Elm Orlu, Butte Copper & Zinc, and Otisco mines, but large decreases at the Butte & Superior, Poser, North Butte, and Moulton properties. Considerable zinc ore was milled from mines in other districts, especially from the Silver Prince, Queen, Galt, Trout, Iron Mountain, and Comet mines. The custom flotation plant for lead-zinc ore was active at Anaconda, and the Timber Butte custom mill at Butte continued to treat custom ore and ore from the Elm Orlu and other Clark properties. Much of the increase in zinc output was due to the treatment of slag at East Helena in the fuming plant of the Anaconda Copper Mining Co.

New Mexico

THE estimated output of gold, silver, copper, lead, and zinc from New Mexico ores in 1928, in terms of recovered and estimated recoverable metal, was 31,546 ounces of gold, 822,478 ounces



Chino mines of the Ray Consolidated Copper Company at Santa Rita, N. Mex.

of silver, 14,462,000 pounds of lead, 88,214,000 pounds of copper, and 65,658,000 pounds of zinc. These figures are to be compared with a production in 1927 of 29,242 ounces of gold, 890,083 ounces of silver, 16,052,855 pounds of lead, 74,251,863 pounds of copper, and 59,603,000 pounds of zinc, and show substantial increases in all metals except silver and lead, for which there were decreases, respectively, of 67,600 ounces and of 1,591,000 pounds. These decreases in silver and lead production were due mainly to the inoperation of the Carnahan mines, in Santa Fe County, and also to the decreased production from mines near Magdalena, in Socorro County. The estimated gross value of the New Mexico metal production is gold $652,114, silver $481,150, lead $882,182, copper $12,879,244, and zinc $3,939,480, or a grand total of $18,834,170, compared with $15,662,076 in 1927, an increase of $3,172,094, or 20.3 percent.

The Pecos mine, operated by the American Metal Co. on Willow Creek, in San Miguel County, showed a marked increase in production over the production in 1927.

The Chino Mines of the Nevada Consolidated Copper Co., at Santa Rita, were operated steadily, but not at full capacity. Ore treated in 1928 was almost entirely from shovel operations, but the development for the future underground mining of the Estrella ore body was continued.

The Lordsburg district in 1928 produced about the same tonnage of siliceous copper-gold-silver ores as it did in 1927, when it shipped 93,406 tons of ore yielding in recovered metals 9,546 ounces of gold, 77,155 ounces of silver, 3,933,496 pounds of copper, and 46,381 pounds of lead. The ore was shipped to smelters at Douglas, Ariz., and El Paso, Tex., where it was used for furnace linings in copper smelting furnaces. Special leaching experiments in 1,000-pound lots, by the Burro Mountain branch of the Phelps Dodge Company, at Tyrone, were continued for part of the year, and leaching of the 1,000,000-ton waste dump was continued during 1928. This is the eighth year of this large leaching operation, and the recovery was naturally small. The Hanover-Bessemer Iron & Copper Company, at Fierro, shipped several thousand tons of copper ore to El Paso, Tex., and several hundred thousand tons of iron ore to the steel plant at Pueblo, Colo. Copper carbonate ores were shipped from Pastura, Guadalupe County, and Scholle, Torrence County. Manganiferous-iron ore from Silver City shipped to the steel plant at Pueblo, Colo., totaled 60,000 short tons.

Gold placers at Pinos Altos, Grant County, and on Ute Creek, Colfax County, the Aztec lode mine at the base of Mt. Baldy, Colfax County, and the Gold Hill district, Hidalgo County, contributed gold bullion. Silver ores were shipped from Chloride, Fairview, Lake Valley, and Kingston, Sierra County.

In addition to the lead concentrates shipped by the Pecos mill in San Miguel County, lead ores were shipped from the Organ Mountain, Hachita, Hanover, Florida Mountains, Los Cerrillos, Steins, and Kelly-Magdalene districts.

Zinc ores and concentrates produced in New Mexico in 1928 amounted to 78,000 tons, containing 79,384,000 pounds of zinc. This production was from Deming, Glorieta, Hanover, Kelly, Los Cerrillos, and Pinos Altos districts. The Empire Zinc Co.'s flotation mill at Hanover was continuously operated during 1928. The Ozark flotation mill at Kelly was idle in 1928. Lessees in the Magdalena district shipped some zinc sulphide ore to Coffeyville, Kans. The Carnahan Mines Co.'s 50-ton flotation mill, at Golden, was idle in 1928. The American Metal Co.'s 600-ton selective flotation mill, at Glorieta, was operated steadily throughout the year except for a shutdown of three weeks due to temporary failure of the aerial tram. The Peru Mining Co. (subsidiary of the Illinois Zinc Co.) continued the operation of its Peru mine at Hanover, and after March operated its newly constructed 100-ton flotation plant at Deming, both on its own ore and custom ore. The new Black Hawk 100-ton selective flotation mill, at Hanover, set in operation August 1, 1928, treated zinc-lead ores from the Lucky Bill group.

Nevada

THE value of gold, silver, copper, lead, and zinc in Nevada increased from $23,322,589 in 1927 to about $31,184,000 in 1928, according to the Bureau of Mines. There was a decided increase in the output of copper and gold, and a slight increase in silver, but the output of lead and zinc decreased slightly. The increase in copper was equivalent to about $7,400,000, which accounts for most of the increase in the total value of the metal output of the state.

The dividends paid by three Nevada mining companies in 1928, according to published reports, amounted to about $7,600,000, nearly all of which was reported paid by the Nevada Consolidated Copper Co., which operated properties in Nevada, Arizona, and New Mexico. Other contributors were the Betty O'Neal and Tonopah Mining Companies.

The gold output increased from $3,107,931 in 1927 to about $3,570,000 in 1928, chiefly on account of the enlarged output of copper ore from the mines at Ely. The Nevada Consolidated Copper Co. was by far the largest producer of gold in Nevada in 1928. It was followed by the Elkoro property at Jarbridge, the Consolidated Coppermines at Kimberly, the Goldfield Consolidated tailings dump at Goldfield, the Gold Circle Consolidated at Midas, the Tonopah Mining at Tonopah, the Flowery property at Virginia City, the White Caps mine at Manhattan, the Round Mountain, Tonopah Extension and Tonopah Belmont mines. The gold output from Storey County (Comstock district) decreased from $271,017 to about $149,000. In 1925 and 1926 mines in the Comstock district produced more gold than those in any other district in the state, chiefly due to the output of the Comstock Merger Mine (Inc.), but in 1927 and 1928 the Robinson (Ely) district was first. In 1928 the Tonopah district was second, the Jarbidge district third, and the Goldfield district fourth. The largest increases in the output of gold were made by the Nevada Consolidated, Goldfield Consolidated tailings, Elkoro, Consolidated Coppermines, Gold Circle Consolidated, and Tonopah Mining Companies. Decreased production of gold was reported by the San Rafael, White Caps, Tonopah Extension, Flowery, and Tonopah Belmont Companies. Gold was also recovered at many new or rejuvenated mines, such as the Basque, Gold Basin, Rochester Canyon, Oromonte, and Olympic properties.

The silver production increased from 5,397,179 ounces in 1927 to about 5,401,000 ounces in 1928, and the value from $3,060,200 to about $3,160,000. The output from the Comstock district (Storey County) decreased from 62,051 ounces to about 20,000 ounces. The Tonopah district produced about 2,000,000 ounces of silver, a slight decrease from 2,167,694 ounces in 1927. The Consolidated Cortez mine south of Beowawe was the largest silver producer in the state, followed closely by the Tonopah Mining Co. Next in rank were the Betty O'Neal, Tonopah Extension, Bristol Silver, and Tonopah Belmont properties. Other large silver producers were the West End Consolidated, Tonopah Divide, Rochester Silver, Elkoro, and Nevada Consolidated properties. Large decreases in the production of silver were reported by the Betty O'Neal, Tonopah Extension, and San Rafael Companies, but the Consolidated Cortez, Bristol Silver, Tonopah Mining, Elkoro, Rochester Silver, and Combined Metals Reduction Companies reported large increases.

The copper output increased from 120,259,276 pounds in 1927 to about 158,577,000 pounds in 1928, and the value from $15,753,965 to about $23,152,000. The Nevada Consolidated Copper Co., operating its mine, mill, and smelter at Ely and McGill, was by far the largest producer of copper in the state and increased its output more than 30,000,000 pounds. Improvements at both the mill and smelter have resulted in a much better

recovery. The mine, however, unlike the Utah Copper property at Bingham, Utah, will soon be worked by a new five-compartment shaft instead of removing the ore by steam or electric shovels. Other large producers of copper that increased their output were the Consolidated Coppermines Corporation at Kimberly, the Mason Valley Mines Co. at Mason, the Bristol Silver Mines Co. at Pioche, and the Copper Canyon property at Battle Mountain. The Consolidated Coppermines was second in the production of copper in 1928, and it was followed by the Mason Valley Mines Co., which ran its smelter at Thompson the entire year. The plant received custom ore from Nevada and California, but most of the copper recovered came from the Bluestone and Mason Valley mines near Mason.

The lead output decreased from 15,784,818 pounds in 1927 to about 15,117,000 pounds in 1928, and the value from $994,444 to about $922,000. The Bristol Silver mine at Pioche became the largest producer of lead as well as a large producer of silver and copper, followed by the Combined Metals property at Pioche and the Yellow Pine mine at Goodsprings. Other large lead producers were the Panther, Richmond Eureka, Nevada Lead & Zinc, Black Forest, and American Beauty properties. The San Rafael property near Fallon, the second largest producer of lead in Nevada in 1927, was being further developed, and the Eureka Holly mine was idle. Large increases in the output of lead were made by the Bristol Silver, Combined Metals, Yellow Pine, Panther, and American Beauty properties. Late in the year a new flotation plant was being constructed at the old Tybo mine in Nye County.

The zinc recovered from ore mined in Nevada decreased slightly from 6,344,523 pounds in 1927 to about 6,333,000 pounds in 1928, and from $406,049 in value to about $380,000. The Combined Metals Reduction Co. nearly doubled its output of zinc from property at Pioche, but the output from the Yellow Pine property at Goodsprings was considerably less, as shipments of lead-zinc ore ceased in June. The largest zinc producer in 1928 was the Combined Metals property in Lincoln County, followed by the Yellow Pine property in Clark County.

Oregon

THE estimated total value of the gold, silver, copper, and lead produced in Oregon in 1928 was $261,000, as compared with $393,657 in 1927, or a decrease of 34 percent. In the yield of metals, silver had the greatest decline—53 percent—followed by copper, with a loss of 46 percent, as compared with 1927.

The gold produced in Oregon in 1928 is estimated at 10,150 ounces, valued at $209,800, a decrease of 31 percent as compared with 1927. The Robert E gold lode mine was a large producer. Development work at both hydraulic and dredge properties caused a large part of the decline in gold yield, so that with the completion of these new plans and the addition of a new dredge gold mining for 1929 is promising.

The yield of silver from Oregon mines in 1928 is estimated at 21,700 fine ounces, valued at $12,700, a decrease of 53 percent in quantity and of 51 percent in value as compared with 1927. The Bay Horse silver mine was idle as in 1927, and the only large silver output reported was from the Buffalo Monitor and from the Queen of Bronze and Cow Boy properties.

Copper produced in 1928 is estimated at 265,000 pounds, valued at $39,000, as compared with 488,200 pounds, valued at $63,954, in 1927, or a decrease of 46 percent in quantity and 40 percent in value. Practically all the copper produced in the state came from mines in Josephine and Douglas Counties.

The lead output in 1928 was a by-product and amounted to about 6,000 pounds, as compared with 5,300 pounds in 1927.

Mining operations at Bingham Canyon, Utah.

Utah

THE mines of Utah in 1928 produced gold, silver, copper, lead, and zinc valued at $79,722,000, an increase of about $6,096,300 over the output of 1927, according to estimates of the Bureau of Mines. A marked increase was reported in copper and gold on account of intensive mining at Bingham after July, but the output of silver, lead, and zinc was less than in 1927. The smelting plants at Murray, Midvale, Garfield, and International were active, and several new mines, such as the North Lily property, that started producing in the latter half of 1927, made a large output in 1928. The production of copper in 1928 was the largest that has ever been recorded. Utah was first in the United States in the production of silver, second in copper after Arizona, and third in lead after Missouri and Idaho. The custom flotation mills at International Midvale, and Bauer were operated the entire year, improved milling plants were run at Park City and Bingham, and the Chief Consolidated flotation plant at Eureka was active most of the year. A new plant designed to precipitate copper from mine water was completed at the mouth of Bingham Canyon by the Utah Copper Co.

The dividends reported paid by mining companies in Utah in 1928 amounted to about $18,507,875, exclusive of $2,927,628 paid by the United States Smelting, Refining & Mining Co., which controls mines at Eureka and Bingham, as well as mines in other states. The companies that contributed to this total were the Utah Copper, Tintic Standard, Silver King Coalition, Park Utah Consolidated, Plutus, Bingham Mines, Chief Consolidated, Utah-Apex, Utah-Delaware, and North Lily. The total compares with $15,663,401 paid in 1927.

The gold production increased considerably from $4,008,451 in 1927 to about $4,301,000 in 1928. As in recent years, practically all the gold was recovered from ores and concentrates smelted. In general the mines of the Bingham district, especially the Utah Copper property, showed a marked increase in the output of gold, and gold from the Tintic district was greater, but the Park City region showed a large decrease. The Deer Trail mine near Marysvale, in Piute County, a large producer of gold from 1918 to 1924, was operated in 1928 by the United States Smelting, Refining & Exploration Co. when it again became a large producer of gold. The largest producers of gold were the Utah Copper, Park Utah Consolidated, United States, Utah-Delaware, Eureka Lilly, Utah-Apex, North Lily, and Tintic Standard properties. Pronounced increases in gold were made by the Utah Copper, Eureka Lilly, North Lily, Deer Trail, Bingham Metals, Bluestone (Stockton Lead), and Live Yankee properties. Ore shipped from the Eureka Standard mine, a new producer in the eastern part of the Tintic district, was chiefly valuable for its gold content.

The silver output decreased from 18,606,950 ounces in 1927 to about 16,682,000 ounces in 1928, but the production was 5,950,000 ounces more than that of Montana, which was second in silver

production in the United States. The value of silver output decreased from $10,550,141 to about $9,759,000. For eight years Utah has been the leading silver producer of the United States. Silver production from the Bingham district increased slightly in 1928, but that from the Tintic district decreased considerably and there was a slight decrease from the Park City region. The Tintic Standard Mining Co. was the largest producer of silver in Utah in 1928. It was followed closely by the Park Utah Consolidated Mines Co. and the Silver King Coalition Mines Co. Next in order came the Utah Copper, United States, Bingham Mines Co. (including Victoria), Ontario, North Lily, Utah-Delaware, and Chief Consolidated properties. Other large producers were the Plutus, Utah-Apex, New Quincy, Mammoth, and Eureka Lilly properties. Increased production was made by some mines, but most of the large silver producers decreased their output decidedly. In August vigorous development work was started by the American Smelting & Refining Co. at the old Silver Reef property near St. George, in the Harrisburg district, Washington County. The property was a large producer of silver from 1875 to 1910.

Copper increased from 256,933,278 pounds in 1927 to about 290,044,000 pounds in 1928, the largest production ever recorded from the state. The value increased from $33,658,259 to about $42,346,000, as a result of the increased price. Utah was second in copper production after Arizona and was far above Montana in 1928. The Utah Copper Co. at Bingham, responding to the increased price of copper, produced 19,360,000 net pounds of copper a month the first half of the year, increased the rate of production to 23,905,488 net pounds of copper a month the third quarter of the year, and made an even better record the fourth quarter. Improvements made at the Arthur and Magna mills brought the combined capacity up to more than 50,000 tons of ore a day, and at the mine electric shovels were installed to replace steam shovels. The recovery of copper in concentrate was increased to nearly 90 percent of the copper in the mill ore, and the grade of the concentrate was greatly improved, especially after dropping the iron. The output from mines of Park City district increased slightly. In the Tintic district the decrease in copper was general, although the Tintic Standard property, the largest copper producer in the region, upheld its output.

The lead output decreased from 302,570,040 pounds in 1927 to about 286,792,000 pounds in 1928, and the value from $19,061,913 to about $17,494,000 as the average price declined. The lead smelting plants were active, but not worked to capacity, although bullion shipments from Murray were increased. Increased shipments of lead ore and concentrate were reported from the Silver King Coalition property where the capacity of the mill was increased by the addition of new flotation equipment. Ten other mines show increased lead output, but nine showed large decreases. The North Lily mine, east of Eureka, more than doubled its output, and the Utah Copper property became an important producer of lead from lead-zinc ore treated at a custom flotation plant. Three large custom flotation plants were operated continuously, as well as the Chief Consolidated mill at Eureka, the Utah-Apex plant at Bingham, and the improved mill of the Silver King Coalition mine at Park City. The Park Galena mill, near Keetley, made a lead-zinc middling from which lead and zinc products were separated by flotation. The Park City region showed a good increase in lead, as did the Rush Valley district of Tooele County, but the lead output from the Tintic, Bingham, and Big and Little Cottonwood districts was less. The largest producers of lead, in order of output, were the Park Utah Consolidated, Silver King Coalition, Tintic Standard, United States, Utah-Delaware, North Lily, Utah-Apex, Bingham Mines (including Victoria), Bullion Coalition, Plutus, Eureka Lilly, and Bluestone Companies. The Eureka Lilly mine, adjoining the Tintic Standard property, became a large producer of silver-lead ore, most of which was milled in the Chief mill at Eureka. Equipment was installed to renew operations at the old Bullion Beck mine at Eureka, new ore was found in the Plutus mine, and new mills were erected at the Hill Top mine near Dunbar and the Prince of Wales property in Big Cottonwood Canyon.

The zinc, recovered chiefly from concentrate leached or smelted, decreased slightly from 99,185,443 pounds in 1927 to about 97,034,000 pounds in 1928. As the average price was less than that of 1927, the value decreased from $6,347,868 to about $5,822,000. All the large flotation mills in Utah treating lead-zinc ore—International, United States, Combined Metals, Silver King Coalition, Utah-Apex, and Chief Consolidated—were operating in 1928, but they were not all worked at full capacity. At Park City there was a general increase in zinc output. At Bingham some of the mines reported less zinc, but the output from other mines increased. Zinc recovered from lead-zinc mill ore of the Utah Copper Co. was doubled. Comparatively little zinc came from the Tintic district, but the Alaska property produced some lead-zinc mill ore. The Chief mill treated no lead-zinc ore, but milled lead ore and siliceous ore from the Eureka Lilly and Chief mines. The largest zinc producers were the Park Utah Consolidated, United States, Silver King Coalition, Utah-Delaware, Utah-Apex, New Quincy, Utah Copper, Ontario, Utah Metal & Tunnel, Bullion Coalition, and Galena King mines.

In 1928 the mines of Utah produced about 18,153,600 tons of ore and old tailings, an increase from 15,757,074 tons in 1927. Of this total the Bingham district produced about 17,352,472 tons, as compared with 14,519,121 tons in 1927. The estimated production of the district was 142,437 ounces of gold, 3,694,300 ounces of silver, 282,854,000 pounds of copper, 100,279,000 pounds of lead, and 46,757,000 pounds of zinc. The production in 1927 was 124,165 ounces of gold, 3,582,084 ounces of silver, 249,918,989 pounds of copper, 111,015,187 pounds of lead, and 49,097,827 pounds of zinc.

The mines of the Tintic district produced 389,880 tons of ore and old tailings, as compared with 446,193 tons in 1927. The estimated production of the district was 33,610 ounces of gold, 6,014,860 ounces of silver, 2,410,800 pounds of copper, 81,766,700 pounds of lead, and 48,000 pounds of zinc. The production in 1927 was 31,253 ounces of gold, 7,591,406 ounces of silver, 3,783,431 pounds of copper, 90,089,355 pounds of lead, and 1,051,534 pounds of zinc. The mines that produced more than 10,000 tons of ore in 1928 were the Tintic Standard, Chief Consolidated, Plutus, Eagle & Blue Bell, Victoria, Mammoth, North Lily, Empire (dump ore), Colorado, Eureka Lilly, and Mammoth tailings dump. The Tintic Standard Mining Co. was first in the production of silver and third in the production of lead in Utah.

The shipments of mill ore, crude ore, concentrates, and middlings from the Park City region decreased from 380,434 tons in 1927 to about 352,400 tons in 1928. The estimated output of the district was 25,760 ounces of gold, 6,704,600 ounces of silver, 3,056,800 pounds of copper, 85,947,700 pounds of lead, and 48,669,000 pounds of zinc. In 1927 the Park City region produced 32,298 ounces of gold, 6,935,267 ounces of silver, 2,595,419 pounds of copper, 82,805,275 pounds of lead, and 44,856,214 pounds of zinc.

There was a fair increase in silver and lead from Tooele County, especially from properties near Stockton, but the output from Big and Little Cottonwood districts was greatly decreased.

South Dakota

METAL mines in South Dakota in 1928 produced $6,615,000 in gold and 89,000 ounces of silver, according to the Bureau of Mines. This compares with the production in 1927 of $6,656,987 in gold and 96,171 ounces of silver. The production of the Homestake mine, the largest producing gold mine in the United States, was apparently slightly less than its 1927 production. Other producing mines in 1928 were the Keystone Consolidated Mines, Inc., near Keystone, which shipped bullion to the Denver Mint and concentrates to the Golden Cycle mill at Colorado Springs, Colo., and one placer mine near Tinton which made a small shipment of bullion to the Denver Mint.

The Trojan Mining Co., in October, 1928, reopened the Trojan mine, formerly an important producer of low-grade gold ore treated by cyanidation, but idle since 1923. This company's plans include driving a 1,700-foot adit to intersect the Two Johns vein. Production from the property is not expected until the spring of 1929.

Texas

METAL mines in Texas in 1928 produced $12,000 in gold, 1,391,000 ounces of silver, 877,000 pounds of lead, and 316,000 pounds of copper. This compares with a 1927 production of $8,192 in gold, 1,034,866 ounces of silver, 487,984 pounds of lead, and 21,458 pounds of copper, indicating a decided increase of all metals. The Presidio mine, operated by the American Metal Co., contributed the greater part of the state's production. This mine has been a consistent producer since 1885, and the 1928 production was the largest in its history.

Shipment of dump material, containing silver, copper, and lead, from the Hazel mine to El Paso continued in 1928. The World Exploration Co. started underground development work at this property in 1928. (*Continued on page* 160)

The COPPER INDUSTRY *in* 1928

THE outstanding feature of the copper industry in 1928, according to the United States Bureau of Mines, was the heavy domestic withdrawals made during the latter part of the year, which caused domestic withdrawals for the year to be the highest for all time, with the exception of 1918. The price of copper increased throughout the year from a monthly average of 13.96 cents a pound in January to 15.9 cents a pound in November and approximately the same in December, according to the American Metal Market. Demand, followed by the highest prices that had been paid since April, 1923, brought forth a response from the mines in the form of largely increased production. Smelter production from domestic ores increased about 10 percent during the year and that this increase is largely owing to heavy production in the latter part of the year is shown by the estimate of smelter production in December, 179,000,000 pounds, which is 27,000,000 pounds higher than the monthly average for the 11 months preceding. As it takes from two to three months for copper in ore mined to appear as refined copper, the increased mine production had not up to the end of the year caused as large an increase in refinery output as it had in smelter output. The increased mine production was not made soon enough to save the producers from drawing largely on their stocks of refined copper to satisfy consumption, and refined stocks have been depleted during the year from 171,000,000 pounds at its beginning to estimated stocks of 95,000,000 pounds on December 31.

The output of recoverable copper by the mines in the United States in 1928 was about 905,500 short tons, as compared with an output of 824,980 tons in 1927, an increase of about 10 percent, according to the Bureau of Mines' figures. There were increases in production in all of the more important copper-producing states due to the increase in the price of copper during the year. Production fell off in Alaska and California.

The smelter production of copper from domestic ores in 1928, as determined by the Bureau of Mines from reports of the smelters showing actual production for 11 months and estimated production for December, was 1,849,000,000 pounds, compared with 1,684,000,000 pounds in 1927. The 1928 production is 10 percent higher than that of 1927, and is the largest peace-time production on record. The estimated smelter production from domestic ores for December as reported by the smelters was 179,000,000 pounds, which is 27,000,000 pounds higher than the average for the 11 months preceding.

MINE PRODUCTION OF COPPER IN UNITED STATES IN 1927 AND 1928, IN TERMS OF THE RECOVERED AND RECOVERABLE METAL CONTENT, IN SHORT TONS

District	1927	1928
Eastern States	11,164	16,000
Central States:		
Tri-State district	.....	.....
Southeastern Missouri	225	.....
Upper Mississippi Valley	.....	.....
Michigan	88,769	89,600
Other	.....	.....
	88,994	89,600
Western States:		
Arizona	341,095	368,100
California	13,566	12,500
Colorado	2,835	4,100
Idaho	1,087	1,100
Montana	111,746	124,300
Nevada	60,130	79,300
New Mexico	37,126	44,100
Oregon	244	100
Texas	11	200
Utah	128,467	145,000
Washington	843	600
	697,150	779,400
Alaska	27,672	20,500
Total	824,980	905,500

The production of new refined copper from domestic sources, determined in the same manner as smelter production, was about 1,763,000,000 pounds, compared with 1,719,000,000 pounds in 1927. In 1928 the production of new refined copper from domestic and foreign sources amounted to about 2,470,000,000 pounds, compared with 2,326,000,000 pounds in 1927, an increase of 144,000,000 pounds, or 6 percent.

The imports of unmanufactured copper during the first 11 months of 1928, according to the Bureau of Foreign and Domestic Commerce, amounted to 699,758,092 pounds, a monthly rate of 63,600,000 pounds, compared with 718,322,990 pounds for the entire year 1927, a monthly rate of 60,000,000 pounds. The total imports for 1928 will very likely show an increase in quantity of approximately 50,000,000 pounds for the year.

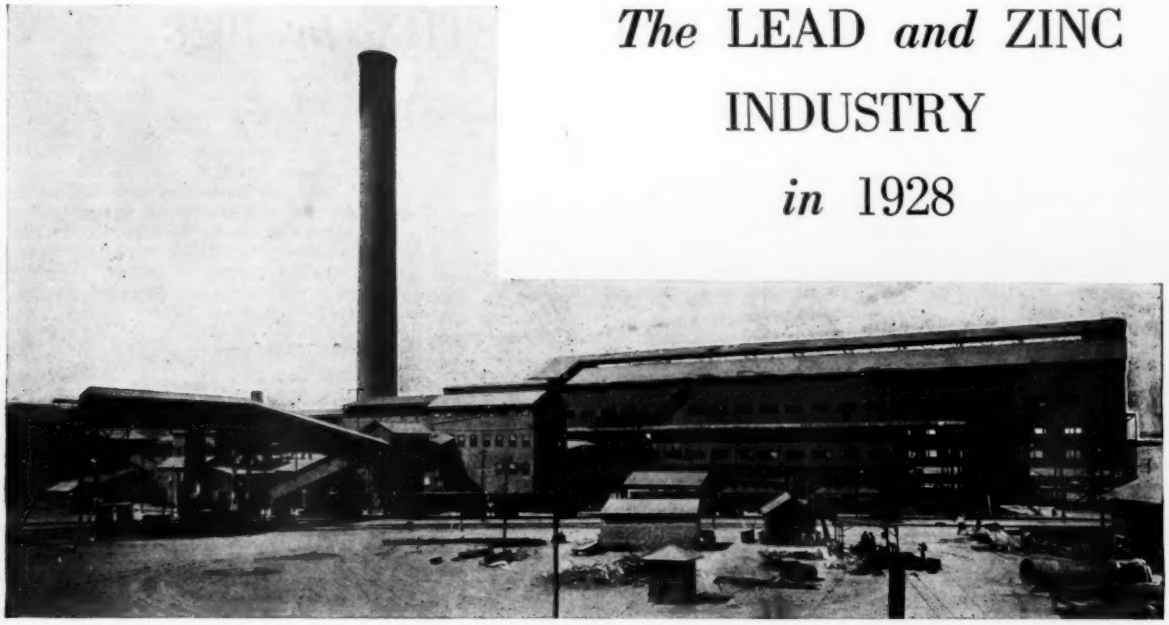
The exports of metallic copper during the first 11 months of 1928 amounted to 1,039,055,909 pounds, compared with 1,069,493,121 pounds exported during the entire year 1927. If the exports of metallic copper in December equal the monthly average for the first 11 months of the year, over 94,000,000 pounds, the total for 1928 will be about 1,133,000,000 pounds, an increase of about 6 percent over the exports in 1927. In the first 11 months of 1928, 946,185,124 pounds of refined copper in ingots, bars, rods, and other forms were exported. Of this quantity Germany received 196,897,805 pounds, the highest amount; the United Kingdom was next with 195,090,988 pounds; and France was third with 156,131,812 pounds. In the entire year 1927 Germany received the largest amount, 221,841,647 pounds; United Kingdom next with 205,598,270 pounds; and France third with 112,721,355 pounds. When figures for December are added, exports to Germany will show a small decrease and those to the United Kingdom an increase. Exports to France for 11 months of 1928 were nearly 39 percent higher than exports for the entire year 1927.

Refineries report that at the end of 1928 approximately 95,000,000 pounds of refined copper would be in stock, a decrease from 171,000,000 pounds at the

(*Continued on page* 160)

Casting blister copper in the McGill, Nev., plant of the Nevada Consolidated Copper Company

The LEAD *and* ZINC INDUSTRY *in* 1928



LEAD

Ore Output

THE recoverable lead contained in ore mined in the United States in 1928 was about 627,300 short tons, as compared with an output of 665,420 tons in 1927, a decrease of nearly 6 percent, according to the Bureau of Mines' figures. The output of soft lead by mines of the Mississippi Valley and a small output from the Eastern States amounted to about 269,900 tons, and that of argentiferous lead by mines of the Western States amounted to about 356,100 tons. Corresponding figures for 1927 were 282,838 tons from the Mississippi Valley and the Eastern States, and 381,574 tons from the Western States. The largest output came from the southeastern Missouri district and amounted to about 193,400 tons, as compared with 196,251 tons in 1927. The output of Idaho came next and amounted to about 145,400 tons, compared with 151,019 tons in 1927. Utah ranked third with an output of about 143,400 tons, compared with 151,285 tons in 1927. In the Joplin district there was a decrease from 81,686 tons to 68,400 tons, 16 percent. All of the important lead-producing states showed decreases in production in 1928.

The price at Joplin of 80 percent lead concentrates was $85 a ton at the beginning of the year, where it remained through the week ended February 4. In the following week prices began to drop and the low for the year, $72.50 a ton, was reached in the first week in March. Prices remained at $72.50 a ton for five weeks and then advanced to $82.50 in the first week in June. This price held for six weeks, then dropped to $80 for the next seven weeks, but recovered to close the year at $85.

Smelter Output

The smelter output of primary domestic desilverized lead in 1928 was about 345,000 tons; of soft lead about 226,000 tons, and of desilverized soft lead about 53,000 tons, making a total output from domestic ores of about 624,000 tons of refined lead, according to statistics compiled by the United States Bureau of Mines. Corresponding figures in 1927 were 378,889 tons of desilverized lead, 233,944 tons of soft lead, and 55,487 tons of desilverized soft lead, making a total of 668,320 tons. The output of lead smelted and refined from foreign ore and bullion was about 156,000 tons, as compared with 128,210 tons in 1927. The total primary lead smelted or refined in the United States in 1928 was thus about 780,000 tons, as compared with a total of 796,530 tons in 1927—a decrease of about 2 percent. The output of antimonial lead in 1928 was about 25,000 tons, as compared with 24,347 tons in 1927.

The imports of refined pig lead for 11 months amounted to 605 tons, of which 546 tons came from Mexico. The base bullion imported during the same period contained 114,836 tons of lead, almost wholly from Mexico. The exports of lead of foreign origin amounted to nearly 98,000 tons, as compared with 122,734 tons exported in the entire year 1927. Exports of lead of domestic origin amounted to 10,858 tons, as compared with 2,533 tons exported in 1927. Exclusive of stocks of lead at smelters and refineries and estimating the amount of lead exported with benefit of drawback, for which figures are not available, it is calculated that the new supply of lead made available for consumption in 1928 was about 653,000 tons, as compared with 663,412 tons in 1927.

According to figures published by the American Metal Market, the average quoted price of lead for prompt delivery at New York for the year was 6.3 cents a pound, as compared with an average selling price of 6.3 cents in 1927. The quotation at the beginning of the year was 6.5 cents and in the closing days of the year it was 6.5 cents. The following are the average monthly prices on lead for prompt delivery at New York, in cents a pound:

January	6.50	July	6.22
February	6.34	August	6.25
March	6.02	September	6.45
April	6.11	October	6.50
May	6.13	November	6.39
June	6.30	December	6.50

MINE PRODUCTION OF LEAD AND ZINC IN UNITED STATES IN 1927 AND 1928, IN TERMS OF THE RECOVERED AND RECOVERABLE METAL CONTENT, IN SHORT TONS (1928 ESTIMATED)

	Lead		Zinc	
District	1927	1928	1927	1928
Eastern States..	2,393	5,500	118,170	143,100
Central States:				
Tri-State dist.	81,686	68,400	330,530	290,000
So'east'n Mo..	196,251	193,400	4,245	3,600
Upper Mississippi Val...	2,141	1,900	33,362	18,000
Michigan ...	.....	.....	.....	.....
Other	367	700	988	200
	280,445	264,400	369,125	311,800
Western States:				
Arizona	9,933	7,400	1,134	600
California ...	1,359	800	4,031	.....
Colorado	33,386	27,000	35,865	32,600
Idaho	151,019	145,400	26,778	30,200
Montana	17,949	16,300	80,231	85,000
Nevada	7,892	7,600	3,172	3,200
New Mex.....	8,026	7,200	29,802	32,800
Oregon	3	3	.....	.....
Texas	244	400	.....	.....
Utah	151,285	143,400	49,593	48,500
Washington ..	478	600	640	13
	381,574	356,100	231,246	232,900
Alaska*	1,008	1,300	.....	.....
Total....	665,420	627,300	718,541	687,800

* Figures obtained from the Geological Survey, Department of the Interior.

ZINC

Ore Output

The recoverable zinc contained in ore mined in the United States in 1928 was about 687,800 tons, as compared with 718,541 tons in 1927, a decrease of 4 percent, according to Bureau of Mines' figures. The output of the Eastern States was about 143,100 tons (71 percent from New Jersey), an increase of 21 percent over production in 1927; of the Central States about 311,800 tons; and of the Western States about 232,900 tons. These figures compare with 118,170 tons for the Eastern States in 1927, 369,125 tons for the Central States, and 231,246 tons for the Western States. Production in (*Continued on page* 160)

Mining Operations on one of the ranges in Minnesota

IRON ORE INDUSTRY INCREASES OUTPUT

THE iron ore mined in the United States in 1928, exclusive of ore that contained 5 percent or more of manganese in the natural state, is estimated by the United States Bureau of Mines at 62,151,000 gross tons, an increase of nearly 1 percent as compared with that mined in 1927. The ore shipped from the mines in 1928 is estimated at 63,244,000 gross tons, valued at $154,491,000, an increase of 3 percent in quantity and of 2 percent in total value as compared with the figures for 1927. The average value of the ore per gross ton at the mines in 1928 is estimated at $2.44; in 1927 it was $2.47. The stocks of iron ore at the mines, mainly in Michigan and Minnesota, apparently decreased from 10,104,673 gross tons in 1927 to 9,266,000 tons in 1928, or 8 percent.

The Bureau of Mines estimates are based on preliminary figures furnished by producers who in 1927 mined about 99 percent of the total iron ore. They show the totals for the principal iron-ore producing states, and, by grouping together certain states, the totals for the Lake Superior district and for groups of southeastern, northeastern, and western states.

Lake Superior District

About 85 percent of the iron ore shipped in 1928 came from the Lake Superior district, in which approximately 52,467,000 gross tons was mined and 53,610,000 tons was shipped, increases of 2 and 5 percent, respectively, as compared with the quantities mined and shipped in 1927. The ore shipped in 1928 was valued at the mines at $133,543,000, an increase of 5 percent. These totals include the ore from mines in southern Wisconsin and ore shipped by rail as well as by water from all mines, but exclude manganiferous ores amounting to approximately 1,080,000 gross tons in 1928 and 1,300,084 tons in 1927 that contained 5 percent or more of manganese in the natural state. The ore is chiefly hematite. The stocks of iron ore in this district apparently decreased from 8,850,638 gross tons in 1927 to 7,980,000 tons in 1928; or 10 percent. The stocks at the end of 1928 were about 1,382,000 tons less than the average for the preceding five years. The shipments of iron ore by water from the Lake Superior district in 1928 (including manganiferous iron ores), according to the Lake Superior Iron Ore Association, amounted to 53,980,874 gross tons, an increase of 6 percent as compared with these shipments in 1927. The average value of the ore at the mines in the Lake Superior district in 1928 was $2.49 a ton; in 1927 it was $2.50.

IRON ORE MINED IN THE UNITED STATES IN 1927 AND 1928 (GROSS TONS—1928 ESTIMATED)

District	Ore mined 1927	1928
Lake Superior:		
Michigan	15,075,079	13,725,000
Minnesota	35,461,138	37,457,000
Wisconsin	1,091,118	1,285,000
	51,627,335	52,467,000
Southeastern States:		
Alabama	6,445,464	6,297,000
Georgia	50,312	91,000
Missouri	78,605	100,000
North Carolina	32,528	.....
Tennessee	121,914	130,000
Virginia	64,592	28,000
	6,793,415	6,646,000
Northeastern States:		
New Jersey	220,660	234,000
New York	853,159	724,000
Pennsylvania	1,170,435	1,022,000
	2,244,254	1,980,000
Western States	1,076,096	1,058,000
Grand Total	61,741,100	62,151,000

Southeastern States

The southeastern states, which constitute the second largest iron-ore producing area, including the Birmingham and Chattanooga districts, mined approximately 6,646,000 gross tons of iron ore in 1928, a decrease of 2 percent as compared with 1927. The shipments of iron ore from mines in these states in 1928 amounted to 6,462,000 gross tons, valued at $12,784,000, decreases of 6 and 8 percent, respectively, in quantity and value as compared with 1927. The ore is mainly hematite; brown ore and magnetite come next in order. The average value of the ore produced in these states in 1928 per gross ton was $1.98; in 1927 it was $2.04. The stocks of iron ore at the mines in this group of states, mainly in the Birmingham district, increased from 873,539 gross tons in 1927 to 1,057,000 gross tons in 1928. These stocks are about 286,000 tons more than the average for the preceding five years.

Northeastern States

The northeastern states, which include the Adirondack district, New York, and the Cornwall district, Pennsylvania, in 1928 mined 1,980,000 gross tons of iron ore and shipped 2,114,000 tons, valued at $6,596,000, decreases of 12 percent in quantity mined, 7 percent in quantity shipped, and 17 percent in value of shipments compared with 1927. The stocks of iron ore in this group of states decreased from 368,331 gross tons in 1927 to 217,000 tons in 1928. These stocks are considerably less than usually carried over at these mines, being about 246,000 tons below the average for the preceding five years. The average value of the ore in these states in 1928 per gross ton was $3.12; in 1927 it was $3.53. Most of this ore is magnetite.

Western States

The western states that ordinarily produce iron ore named in order of their importance are Wyoming, Utah, New Mexico, Colorado, Montana, and Washington. Occasionally California, Idaho, and Nevada contribute small quan-

tities. All the ore from Wyoming, New Mexico, and Colorado and most of that from Utah is used for the manufacture of pig iron. Much of the remainder is used as a flux in smelting copper and the precious metals. It is estimated that the western states mined and shipped in 1928 approximately 1,058,000 gross tons of iron ore, valued at $1,568,000, a decrease of 2 percent in the quantities mined and shipped but an increase of 2 percent in value of shipments as compared with 1927. The ore comprises hematite, magnetite, and brown ore.

Imports and Exports

The imports of iron ore reported for the 11 months ended November 30, 1928, amounted to 2,280,247 gross tons, valued at $4,996,191, or $2.19 a ton. The imports for the year 1927 were 2,620,717 gross tons, valued at $6,068,283, or $2.32 a ton. The reported exports of iron ore for the 11 months ended November 30, 1928, amounted to 1,269,202 gross tons, valued at $4,764,143, or $3.75 a ton, as compared with exports for the entire year 1927 of 898,793 tons, valued at $3,425,435, or $3.81 a ton. These statistics of imports and exports were compiled from the records of the Bureau of Foreign and Domestic Commerce, of the Department of Commerce.

The above table shows the quantity and value of the iron ore mined and shipped in the United States by the principal producing states. The figures for 1927 are final, but those for 1928 are subject to revision.

LEAD and ZINC in 1928 (*From page 158*)

the Joplin district decreased from 330,530 tons in 1927 to 290,000 tons in 1928, approximately 12 percent. In the Western States as a whole production was a little higher. Increases were made in Idaho, Montana, and New Mexico. The other Western States showed relatively little change or decreases in production in 1928.

At the beginning of the year the price at Joplin of 60 percent zinc concentrates was $36 a ton. The price ranged between $35 and $38 a ton until the third week in March, when it reached $40. For the next six weeks the price held at $38, then advanced to $40 a ton in the third week in May. This price held for the remainder of the year.

Smelter Output

The output of primary metallic zinc from domestic ores in 1928 was about 582,100 tons and that from foreign ores was about 12,400 tons, a total of 594,500 tons, as compared with 576,960 tons from domestic ores and 15,556 tons from foreign ores, a total of 592,516 tons in 1927. In addition to the output of primary zinc there was an output of about 52,100 tons of redistilled secondary zinc, as compared with 42,784 tons in 1927, making a total supply of distilled and electrolytic zinc in 1928 of about 646,600 tons, composed of 238,200 tons of high grade and intermediate, 80,100 tons of select and brass special, and 328,300 tons of prime western zinc. Of the total output of primary zinc in 1928, 160,000 tons was electrolytic zinc produced in Montana and Idaho, 105,000 tons was made in Pennsylvania, 104,000 tons in Illinois, 103,000 tons in Oklahoma, and the remainder in Arkansas, Indiana, Kansas, Texas, and West Virginia.

The imports of slab zinc for 11 months amounted to only 3 tons. The exports of slab zinc made from domestic and foreign ores amounted to 27,855 tons, including 3,869 tons of rolled zinc.

The total number of retorts at the 21 zinc smelters that operated during all or a part of the year was about 107,000. Of that number, about 63,400 were reported in operation at the end of November and about 63,400 were expected to be in operation at the end of the year. At the end of 1927 there were 77,388 retorts in operation at these 21 plants.

Figures published by the American Metal Market give an average quoted price of 6.03 cents a pound for prime western zinc at St. Louis in 1928, as compared with an average selling price for all grades in 1927 of 6.4 cents. At the opening of the year the quotation was 5.65 cents a pound and the quotation throughout December was 6.35 cents a pound. The following are the average monthly prices on prime western zinc at St. Louis, in cents a pound:

January	5.65	July	6.20
February	5.55	August	6.25
March	5.63	September	6.25
April	5.76	October	6.25
May	6.04	November	6.27
June	6.16	December	6.35

MINERAL PRODUCTION in UNITED STATES (*From page 156*)

The Mohawk mines also continued shipments of copper-silver ore to El Paso in 1928.

Washington

THE value of the gold, silver, copper, lead, and zinc produced from ore mined in the state of Washington in 1928 was about $626,000 as compared with $854,659 in 1927, according to estimates made by C. N. Gerry, of the Bureau of Mines. There was an increase in the quantity of recovered lead, but decreases in the output of gold, silver, copper, and zinc, and the decreases in gold and zinc were large.

The production of gold decreased from $403,380 in 1927 to $334,000 in 1928. The output of gold and silver in the Republic district, which produced nearly all the gold in the state, decreased from $376,932 in 1927 to about $285,000 in 1928. The Quilp mine, which increased its output, was by far the largest gold producer, followed by the group operated by the Aurum Mining Co., formerly owned by the Northport Smelting & Refining Co. The Last Chance mine of the Lone-Pine Surprise Consolidated Mining Co. and the Insurgent property, under lease, were also large producers of gold, but their output was much less than that of 1927. The Boundary Red Mountain Mining Co., south of Sardis, British Columbia, was the third largest producer of gold in Washington, although the output decreased. Some placer mining was done at Liberty, but the dredge of the Kittitas Gold Mining Co. was not operated regularly.

The output of silver in the state decreased from 155,850 ounces in 1927 to about 94,000 ounces in 1928. The Republic district produced most of the silver, chiefly from the Surprise-Lone Pine-Pearl group of the Aurum Mining Co., the Quilp, and the Last Chance mines. Other producers of silver were the Chewelah Union property at Chewelah, from rich silver-copper ore, and the Insurgent property at Republic, from gold ore.

The output of copper decreased from 1,685,848 pounds in 1927 to 1,121,000 pounds in 1928, and the value from $220,846 to $163,000, despite the increase in the price of copper. The Sunset Copper Co., near Index, the largest producer of copper in the state, ran its mill regularly but made fewer shipments of copper concentrate. Other producers of copper were the Chewelah Union at Chewelah and the Turk mine, operated by the Snowdrift Mining Co. A mill was constructed at the Turk mine late in 1927 but operated only a short time in 1928. The Royal Development Co. continued a campaign of vigorous development work and late in the year it was reported that ore had been opened in the Liberty tunnel.

The output of lead increased slightly from 955,003 pounds, valued at $60,165, in 1927 to about 1,180,000 pounds, valued at $72,000, in 1928. The Gladstone mine, near Northport, in Stevens County, was the largest producer of lead in 1928, but the output was small when compared with past years. Other producers of lead were the Electric Point, near Northport; the Young America, near Marcus; the Silver Queen, at Springdale; the Boundary Silver-Lead Co., at Boundary; and the Red Top mine, near Northport.

The production of zinc decreased from 1,279,710 pounds in 1927 to about 26,000 pounds in 1928, as a result of the idleness of the mills at Metaline Falls and Northport. No shipments of concentrate were made from either the Black Rock or Pend Oreille mines, both large producers in 1927. One car of crude lead-zinc ore was shipped from the Great Western mine, near Northport. A new mill was constructed for the Grandview mine and considerable work done in developing lead-zinc ore at Metaline Falls, in Pend Oreille County.

The Lone-Pine Surprise Consolidated Mining Co., it is announced, paid a dividend of $31,260 in August and was the only mining company in Washington reported to have paid a dividend in 1928.

Wyoming

METAL mines in Wyoming in 1928 produced 33 ounces of gold and 13 ounces of silver, compared with production in 1927 of 58 ounces of gold and 5 ounces of silver, according to the Bureau of Mines. The production was in the form of bullion from the Atlantic City district in Fremont County.

COPPER INDUSTRY in 1928 (*From page 157*)

end of 1927. It is estimated that stocks of blister copper at the smelters, in transit to refineries, and at refineries, and materials in process of refining, would be about 378,000,000 pounds on December 31, compared with 401,000,000 at the end of 1927, a decrease of 23,000,000 pounds. Therefore, a decrease of 99,000,000 pounds in total smelter and refinery stocks is indicated.

The quantity of new refined copper withdrawn on domestic account during the year was about 1,588,000,000 pounds, compared with 1,423,000,000 pounds in 1927, an increase of 165,000,000 pounds, or approximately 12 percent. Domestic withdrawals in 1928 were the highest ever recorded, with the exception of those in 1918.

The MANGANESE SITUATION *in* 1928

A manganese mine in Montana

THERE was very little change in the domestic shipments of manganese ore containing 35 percent and more of metallic manganese in 1928, which totaled approximately 45,000 long tons, valued at $1,197,000, according to preliminary figures compiled by the Department of Commerce and made public by the United States Bureau of Mines. The 1927 shipments amounted to 44,741 tons, valued at $1,151,918. The shipments of metallurgical ore amounted to 30,000 tons, valued at $561,000, while those of 1927 were 27,730 tons, valued at $446,781. The shipments of chemical ore in 1928 amounted to 15,000 tons, valued at $636,000, while those of 1927 were 17,011 tons, valued at $705,137.

The plant owned by the Domestic Manganese and Development Co. was put in operation during March and treated rhodochrosite ore from the Emma mine at Butte, Mont., operated by the Anaconda Copper Mining Co. It produced 11,118 tons of calcined and nodulized material containing 56.45 percent manganese. This quantity was derived from 18,000 to 19,000 tons of crude carbonate ore. Statistics for previous years have included production of such crude ore, as prior to 1928 most of the Montana carbonate ores were not beneficiated before shipment. There was also some metallurgical ore shipped from Philipsburg in the early part of the year, but the quantity was small. Philipsburg shipped 14,300 tons of chemical ore in 1928, compared with 16,382 tons in 1927. Arkansas' shipments of high grade ore increased from 2,605 tons in 1927 to 3,800 tons in 1928. There was a large increase in shipments of high grade ore from Georgia, and a large decrease in shipments from Idaho. No high grade shipments were reported for Nevada in 1928.

Figures furnished by the Bureau of Foreign and Domestic Commerce show that during the first 11 months of 1928 the metallic content of imported ore was 185,490 tons. The gross tonnage was 386,734 tons. Assuming that the imports for December were at the same rate as during November, the total importation would be approximately 420,000 tons as compared with the total imports of 622,067 long tons in 1927. The imports of manganese ore from Soviet Russia for the first 11 months of 1928 amounted to 152,746 tons, compared with 253,544 tons for the entire year of 1927. Brazil furnished 120,000 tons for the first 11 months of 1928, compared with 174,026 tons for the entire year of 1927. India furnished 76,600 tons for the first 11 months of 1928, compared with 93,017 tons for the entire year of 1927. The imports from British West Africa (Gold Coast) for the first 11 months of 1928 amounted to 24,186 tons, compared with 87,230 tons for the entire year of 1927.

For the first 11 months of 1928 the manganese content of ferromanganese imported was 44,325 tons as compared with 34,018 tons for the entire year 1927.

There was a record production of steel in 1928, estimated at 51,400,000 tons of ingots and castings, and a consequent demand for ferromanganese and in turn for manganese ore. The estimated production of ferromanganese in 1928 is given in the *Iron Trade Review* of January 3, 1929, as 316,000 tons, compared with 294,991 tons in 1927, and second only to the outputs of 1918 and 1926. The domestic production of manganese ore, however, was little changed in 1928, and imports decreased from 622,067 tons of ore in 1927 to 386,734 tons in the first 11 months of the year and approximately 420,000 tons for the entire year. At the rate of manganese ore consumption per ton of ferromanganese produced, reported by ferromanganese producers in 1927, the domestic production of ferromanganese in 1928 required approximately 632,000 tons of manganese ore. Assuming that the amount of manganese ore imported for chemical uses was offset by the quantity of metallurgical manganese ore produced in the United States in 1928, approximately 420,000 tons of ore was available for metallurgical uses in 1928, 212,000 tons less than was required by the producers of ferromanganese. Most of this tonnage is accounted for by the decrease in the quantity of manganese ore in bonded warehouse, officially reported as 183,477 tons of manganese content on December 31, 1927, and 96,918 tons on October 31, 1928, a decrease of 86,559 tons of manganese content, equivalent to at least 173,000 tons of manganese ore. The remainder of the ore required, between 35,000 and 40,000 tons, must, therefore, have been drawn from stocks at the plants of consuming companies.

The shipments of domestic ore containing from 10 to 35 percent of manganese (ferruginous manganese ore) in 1928 were 87,000 tons, valued at approximately $391,000, as compared with 148,291 tons, valued at $673,921 in 1927. The domestic shipments of ore containing from 5 to 10 percent of manganese (manganiferous iron ore) in 1928 were 1,090,000 tons, valued at $2,640,000, as compared with 1,310,127 tons, valued at $3,270,460 in 1927. The decrease in shipments of ferruginous manganese ore was contributed to mainly by Colorado, Georgia, Michigan, and New Mexico. The apparent decrease in shipments of manganiferous iron ore is due to the falling below 5 percent manganese content of ore in Wisconsin that contained over 5 percent in 1927. Shipments from Minnesota, 1,029,000 tons in 1928, showed an increase over the 934,599 tons shipped in 1927.

Expansion in the ferromanganese production of American blast furnaces has been a feature of recent years, according to the *American Metal Market*. Production has gone up, imports have been reduced and consumption has increased.

Before the war, in 1913, imports exceeded production and were nearly 52 percent of the country's consumption. In 1928 production was over 150 percent larger than in 1913 with imports only about 16 percent of total consumption. In 1926 and 1927 nearly the same proportions in imports ruled. Thus our production in the last three years has increased about 150 percent in excess of the pre-war and our imports have decidedly declined while consumption has increased about 50 percent. Thus imports have declined from 51.7 in 1913 to about 14 to 16 percent in the last three years.

HEARINGS *on* COAL LEGISLATION

Senate Committee On Interstate Commerce Concludes Arguments On Legality Of Proposed Legislation To Regulate The Coal Industry — Decision On Legislation Hinges On Whether Coal Is Impressed With A Public Interest—Coal Interests Declare Legislation Unnecessary And Are Supported By National Chamber Of Commerce—Railroads In Opposing Regulation Say It Would Increase Freight Rates

AFTER more than a year of consideration, including the taking of voluminous testimony and the hearing of extended arguments, the Senate Committee on Interstate Commerce has completed open committee consideration of proposed legislation to regulate the bituminous industry with a view to its stabilization. Consideration of the subject was begun in January, 1928, with an investigation of conditions in the coal fields of West Virginia, Ohio, and western Pennsylvania in connection with the walk-out of union mines, which has since been terminated by district agreements.

From January 14 to 22, 1929, the committee held continuous daily sessions to complete the hearings on the proposed legislation. The only bill before it was a measure drafted by the miners' union authorizing consolidations in the coal industry and the licensing of corporations under regulation of a commission with power to fix wages and prices. Representatives of the coal industry were a unit in opposing the legislation as unconstitutional and economically unsound and offered no substitute on the ground that if left alone the industry can work out its own salvation. Representatives of railroads in opposing the legislation predicted that if enacted it would upset the fuel-purchasing policy of railroads, which is based on engineering principles, and would also result in increased freight rates.

The committee will now consider the bill in executive session, and even should it recommend legislation of this or any other character it is unlikely that Congress can act on the question at this session, in view of its adjournment on March 4. It is believed that the decision of the committee will revolve around the question whether coal is impressed with a public interest to justify Federal regulation, as Senators during the investigation conceded that without such public interest Congress could not impose Federal regulation on the industry. While some of the Senators feel that recent Supreme Court decisions hold that the mining of coal is not impressed with a public interest, they say that this decision is based only on the commerce clause, and that Congress could act under its power to legislate for the public welfare.

Dr. S. C. Duncan, economist of the Association of Railway Executives, gave interesting data on the policies of railroads in the purchase of fuel. Because of its importance to the coal mining industry, his remarks are herewith given in extensio:

Railroad Coal

"While Class I carriers represent a large and important demand for bituminous, this demand is not an undiscriminating one. For efficient operation they must have the right kind of coal.

"A carrier will purchase coal for a large number of different uses, as for heating stations and office buildings, the operation of small stationary boilers and in terminal shops, for the generation of power for local use, low-volatile coal for use on locomotives operating in terminals where the volume of smoke is restricted by city ordinance, smithing coal for shop purposes, specially sized coal for use on passenger, freight and yard locomotives equipped with stokers, special coal for use on passenger, freight and yard locomotives not equipped with stockers and for use in electric power houses for generating power for train operation in electrified zones. Even the ruling gradient of an operating division may exclude certain kinds of coal that would be serviceable on operating divisions with other gradients.

"For economy of operation and efficiency in management, railroad fuel requirements demand coal of definite character, obtainable in certain regions only, owing to the peculiar qualities of the coal. Broadly speaking, gas coals are used for heavy duty, high-speed passenger service; low-volatile coals for blacksmithing and power purposes in territories where excessive smoke is to be avoided; and medium and high-volatile coals for freight service, branch line passenger service and bunkers of marine equipment.

"The locomotive equipment of railroads is designed for and adapted to certain character of coals that necessity and experience have proven best suited for economical and efficient service and operation. Each railroad has its own peculiar problem as to types of locomotives, character of train service, operating conditions and location. There is no such thing as a common quality of coal for the use of the carriers. Each railroad has a different fuel requirement, and within each railroad different qualities of coal are demanded for specific purposes.

"The buying of coal for a railroad becomes a technical problem. The selection of locomotive coal is distinctly an engineering problem, and its correct solution for each railroad can only be determined by qualified fuel engineers familiar with the local conditions peculiar to the individual railroad.

Fuel Purchasing

"With the great variations in the character of coal, with the varied uses for coal on the railroads, and with the continuity and adequacy of a complete supply so essential, there must be a well-organized purchasing department, equipped by a personnel of highly trained experts. These men must know coal. They must know mines, coal seams, the chemical and physical qualities of coal. They must know coal performance. They must know coal markets and prices. They must have a detailed and intimate knowledge of the coal needs and requirements of the individual carrier. There is no more important element in the efficient operation of a railroad than the proper selection of coal.

"The difficulty and complexity of the problem of selecting coal for railroad operation may be illustrated by example. Take the case of a large eastern road. It is known as a coal road. There are 268 coal mines located on its lines which are in condition for operation. These mines are owned by nearly 200 separate companies. The road consumes something like 3,200,000 tons of coal per year. Of this amount, it produces from its own four coal tipples about 1,400,000 tons, leaving a balance of about 1,700,000 tons to be purchased.

"If the purchases of this road were divided equally among the 200 owning companies, the average annual tonnage per company would be only about 9,000 tons, or about one-half a carload per calendar day.

"But the coal produced at these mines comes from 27 distinct coal seams having different composition and characteristics. About 65 percent of the tonnage is from seams rated as low-volatile coal; that is, coal containing volatile matter ranging from 15 to 22 percent. The remainder is from seams rated as high-volatile coal, in which the volatile matter ranges from 28 to 35 percent. Experience on this road has shown definitely that coal of different characteristics, especially coals with a considerable variation in the percent of volatile matter, can not be satisfactorily used as a mixture.

"Of the coal used on this road, less than 25 percent is in run-of-mine form. The other 75 percent or more is fired with stokers. The stoker equipment, grates, etc., are designed to handle economically a mixture of slack and the smaller sizes of coal. A grade such as this must be obtained from mines that are equipped to screen coal to the desired size and that are willing to do so by reason of having a market for their resulting grades of coal.

"Experience on this road has developed that although 65 percent of the production of the mines on its lines is low volatile in character, the high-volatile coal is the most economical and desirable for over 80 percent of the total requirements when measured in tons.

"From this illustration may be seen some of the complexity and difficulty that faces the personnel which must secure the right kind of coal in an adequate supply for the efficient operation of a railroad. It is not a simple matter. It is a technical engineering problem that varies not only from road to road but from season to season and from service to service.

"So vital is coal to the operation of a

railroad that, despite all difficulties, complexities, and obstacles in the way, a carrier must be assured of a continuous supply. This paramount responsibility faces the fuel-purchasing department of each and every railroad.

"In distributing the purchases, the coal purchasing agent for a carrier must, among other things, give consideration to:

"(a) The ability of mines to produce the character and size of coal required.

"(b) The ability of mines to make delivery when and as needed, adequate both as to quantity and quality.

"(c) Cost, convenience, and reliability of deliveries.

"(d) The past experience with a mine as to its willingness to accept a fuel contract and ability to undertake the performance called for thereunder.

"(e) The suitability of the coal for the purpose required, when properly prepared.

"(1) The equipment of the mine for proper removal of impurities and the good faith of the mine in doing so as determined in the course of past relations.

"It has been calculated that a reduction of as little as 5 percent in the heat content of coal used in locomotives would require the additional consumption of 6,250,000 tons of coal, or 125,000 50-ton cars, per year by Class I railroads. A difference of only 1 percent in ash content in locomotive fuel requires 25,000 50-ton cars per year to haul the coal to locomotive coaling stations, with the consequent effect upon combustion efficiency and the disposal of the additional burden of refuse still to be considered. These facts indicate the nicety of judgment required in securing such splendid economies as the performance record of the railroads indicates."

Dr. Duncan attacked the provision giving the proposed coal commission authority over railroad fuel service and railroad lines to mines. He said the legislation would handicap the railroads. While the increasing use of fuel oil and electric power, together with coal economies practiced by railroads, have prevented a natural increase in coal purchases by them. Dr. Duncan said bituminous is the main source of railroad fuel requirements. He insisted that the railroads should be given freedom in the purchase of their coal, including the selection of mines from which purchased. Ample authority for supervision of railroad management already exists in the Interstate Commerce Commission and no further legislation is required. Dr. Duncan said the legislation would increase the cost of coal and the cost of railroad operation. While requiring the railroads to buy from certain mines, the bill does not require producers to sell to railroads.

Freight Advance

"With railroads as a whole earning less than the rate of return established by law, the increase in the cost of fuel resulting from this legislation would have to be made up by an increase in rates," said Dr. Duncan.

Retail coal interests opposed Government regulation of the bituminous industry. Their hearing was marked by a sharp exchange between Roderick Stephens, of New York, chairman of the governmental relations committee of the National Retail Coal Merchants Association, and John L. Lewis, head of the union. When Mr. Stephens stated that he doubted that Congress would alienate consumers in order "to curry favor with a leadership of a discredited union, which has lost its hold on its own members and forfeited the good will of the public, by a policy of strikes, violence, and disregard of Federal authority and public welfare," Mr. Lewis challenged "the truth of that vicious statement, which is offensive."

Senator Wheeler (Dem., Mont.), acting chairman in the absence of Senator Watson (Rep., Ind.), asked in what manner the union had disregarded Federal authority. Mr. Stephens said the union had refused the invitation of the late President Harding to arbitrate strikes, and also referred to riots conducted by the union at Herrin, Ill. Senator Wheeler thought Mr. Stephens' declaration was unwarranted on that statement of facts. "The history of the union will warrant my statement," said Mr. Stephens.

Mr. Stephens later appeared to give instances where the union had disregarded Federal authority, but Senator Wheeler, who requested the information, said Mr. Stephens was not helping the situation by denouncing the union. Mr. Stephens was prepared with a 10-page statement in support of his charges against the union, but read only two pages, setting out a loss of union membership and control of the coal fields when the committee decided not to receive the full statement, on motion of Senator Glenn (Rep., Ill.). Mr. Stephens said the union policy was involved because the legislation had been drafted by the union. Mr. Lewis said he was "outraged" at this "slander" and "indignant" at the criticism. Mr. Stephens said the union had disappeared from Pennsylvania (except in the anthracite industry), Maryland, West Virginia, Ohio, Kentucky, Tennessee, Arkansas, Oklahoma, Colorado, and Washington. While in 1920 union mines produced 70 percent of bituminous, they now produce one-fifth of the output, and the number of men employed in union mines is 38 percent less than those employed in 1920.

Pennsylvania Operators Object

Alfred M. Liveright, attorney for the Central Pennsylvania Coal Producers Association, declared that the primary purpose of the legislation is to safeguard the rights and position of the union. He did not think the industry should be fettered by selling pools, cooperative associations, mergers, consolidations and combinations subject to regulatory provisions and supervision. He said the industry was entitled to the same freedom as is accorded other industries and the miners themselves. He pointed out that other industries have not been bound by requirements to submit to regulation or to be restricted by licenses. He said the primary purpose of the legislation is to control the price of coal, but that this could not be done under decisions of the Supreme Court. The bill also violates the Constitution because it deprives persons of their property without due process of law. He declared that the coal industry is not affected with a public interest and is not subject to Government price fixing. He stated that gasoline has as wide a distribution as coal, but that the Supreme Court in a recent case in Tennessee had held that the gasoline industry is not subject to regulation by the state. Mr. Liveright stated that Congress should defer action until the Supreme Court acts on a pending case involving the right of the President to fix maximum prices for coal during war. He declared that the legislation attempts to regulate the production of coal, which is a state function. The bill was also declared to be faulty in that it does not prescribe any standard of guilt respecting criminal punishment for charging unreasonable rates. Particular objection was made to the prohibition against shipment of coal in violation of regulations of the proposed commission.

"From beginning to end the bill violates the maxim that Congress may not delegate its legislative power to a commission," said Mr. Liveright. "Congress must lay down general rules under which the commission shall proceed, must decree the policy of the law and fix legal principles to govern given cases." Mr. Liveright said the provision basing maximum prices on fair wages and fair returns on invested capital would be unworkable because no standard is fixed by the measure for determining the manner or method in which the fair return is to be measured. He referred to the difficulties experienced by the Interstate Commerce Commission in determining fair returns on railroad valuations, even under prescribed standards, the case now being before the Supreme Court for decision. He declared that without any guide the proposed coal commission could not determine a fair return on invested capital. Mr. Liveright stated that valuations had been the stumbling block in proposed coal mergers in West Virginia and Pennsylvania. He said confusion would result because of differing decisions of courts as to the reasonableness of maximum prices.

W. P. Belden, of Cleveland, representing the Ohio Coal Operators Association, said Congress should either let the coal industry alone or provide for its control and operation by the Government. He opposed the latter proposition, but said the industry could not solve its problems under the continuous cross-fire of congressional investigation and criticism. Senator Couzens (Rep., Mich.) developed the fact that there have not been mergers in the coal industry because the companies are unprofitable, as mergers embrace profitable concerns. Mr. Belden said the same situation exists with respect to oil and that Congress should face the situation and reach a decision as to what it intends to do. He opposed the pending legislation to regulate the industry under a commission on the ground that it invaded the field of private industry. He declared that coal production is not a public utility subject to Government control or impressed with a public interest, but Senator Wheeler predicted the time when the courts will hold that coal is a public utility. Mr. Belden declared that Congress could not fix the price at which coal may be sold by an operator or purchased by a consumer. He declared the bill to be both constitutionally and economically unsound.

Let Industry Alone

"Coal companies must be entrusted with the operation of their business and be allowed to work out their own ills," said Mr. Belden. "But if the coal indus-

try is considered of such vital importance to the Nation, Congress should take over its operation in the interest of conservation." Mr. Belden said coal is no different from oil, although the Government operates oil properties through leases. He contrasted the proposed regulation of the management of the mines under the pending legislation with that imposed by the states regarding safety for the miners. Mr. Belden declared that no emergency exists for the legislation as coal is being furnished at low prices. In attacking the license provisions of the bill, Mr. Belden said it would permit the commission to give preference to certain mines as to the matter of the quality of coal or labor conditions in the mines, which he declared to be unfair. Another objection to the bill was that it established no procedure or measure of rights to which applicants for licenses were entitled. Senator Wheeler said the commission could deny licenses on the basis of public welfare, and not on the basis of injustice to producers. Mr. Belden declared that the courts had decided that the mining of coal is a private enterprise, not impressed with a public interest and not of an interstate commerce character, and therefore not subject to Government regulation. Mr. Belden declared that the bill also forbids mergers unless the companies surrender their rights, which practice is not required in other business mergers. He thought existing laws sufficient to bring about consolidations. The bill also restricted the right of companies to employ nonunion labor. Senator Wheeler admitted that business could employ labor irrespective of whether it was affiliated with the union or not. Mr. Belden said that as result of their experiences with the union in prior years, Ohio operators were not employing nonunion miners and that conditions in those fields are satisfactory. He admitted that the union had been beneficial, but insisted that the troubles in the industry have arisen because of union agitation. Mr. Belden admitted that both coal and oil are being wasted under present methods of production and low prices, as operators are forced to take out the products which can be produced at lowest cost.

Opposition to the legislation came also from the U. S. Chamber of Commerce. The chamber representatives contended that the coal industry is competent to solve its problems and objected to Government regulation of this or other industries. F. M. McWhirter, banker of Indianapolis and director of the chamber, said the organization did not object to reasonable legislation affecting the coal industry where the public interest required, but took exception to legislation giving the Government such control either through bureaus, commissions, licenses or other agencies amounting to Government operation of industry. He contended that no sound permanent solution of coal problems can be had through the type of Government control contemplated by the pending bill. On the other hand, such control would add to confusion in the industry. When Mr. McWhirter said the proposed coal commission would function as a promotion and advertising agency, trade-marking coals and furnishing information concerning them to domestic and foreign purchasers, and diplomatic agents of the Government, Senator Wheeler said the Government is doing the same thing through advice as to the best things to use in many lines of industry. "A more complete usurpation of the function of business in industry can hardly be imagined than is proposed in this measure," said Mr. McWhirter. Asked by Senator Wheeler if the chamber had anything to offer to solve the coal question, Mr. McWhirter said it had not.

Safety Work by Industry

Charles F. Conn, of Philadelphia, president of a cement company and member of the natural resources department of the chamber, opposed the legislation as unnecessary because the coal industry is able to work out its problems. He stated that the cement industry is developing a process of combining good grades of cinder with cement and moulding it into building blocks which is contributing to more complete utilization of coal and broadening its use. The cement industry is obtaining adequate supplies of satisfactory quality coal at reasonable prices, and he saw no cause for alarm or shortage of fuel. Conditions will become stabilized under the law of supply and demand. Even in strikes the industry has been so handled as to prevent serious disturbance to the country. "If let alone, the industry will perform its obligations to the public," said Mr. Conn. "The industry should be given entire freedom in handling its internal problems." He predicted that the proposed coal commission would cost more than the Interstate Commerce Commission, whose expenses are now nearly $8,000,000 a year. "If Congress wishes to aid the coal industry it should increase present inadequate appropriations for mine safety and research," said Mr. Conn. "There is a definite need for additional mine rescue cars, research in production, conservation and utilization of coal and its products."

Senator Wheeler raised the question as to why the coal industry should not conduct its own mine rescue and safety work. Mr. Conn wondered if Congress would extend the proposed regulation to the anthracite, petroleum, iron and other industries. "Industries responsible for production of basic raw materials are conscious of their duties and obligations, and if permitted may be relied upon to do everything in the general interest more effectively than through Government control," said Mr. Conn. Mr. Lewis suggested that operators make their mines safer so as to prevent disasters, which is one of the purposes of the bill.

Charles H. MacDowell, president of the Armour Fertilizer Works of Chicago, and member of the natural resources department of the chamber, stated that during the recent bituminous suspension, his interests were able to obtain adequate supplies of coal at reasonable prices. "There is no acute coal problem," he said.

The Government should refrain from entering business which can be successfully performed by private enterprise. He said the bituminous industry is competent to handle its problems. The coal industry had been active in setting up business practices for improvement of its condition in the form of self-regulation.

Senator Black (Dem., Ala.) agreed that if a business is successfully operated with regard to the public, employes and employers, it should not be regulated by the Government, but he asked if the Government had the right to regulate a business which is not successfully conducted. Mr. MacDowell said it is not necessary for the Government to control and regulate such a business, but that the industry should work out its problems through research and better and efficient methods. Business could cooperate with the Federal Trade Commission in working out these problems. Attorney Warrum, for the union, referred to the fact that the bill regulating stockyards had been opposed along the lines of the opposition advanced to the coal legislation, and Mr. Lewis asked questions indicating his lack of confidence in the ability of the coal industry to set up a policy of self-control.

Economic Objections

Economic reasons against the legislation were advanced by Gus W. Dyer, professor of economics of Vanderbilt University of Nashville, who insisted on the largest possible freedom to the individual to direct his affairs in his own way under his own authority with the least possible interference from the Government or any other outside force. "The only ground on which the Government can restrain his freedom is that he is interfering in an unwarranted way with the freedom of others," he said. He declared that the function of the Government in relation to business regulation is similar to that of an umpire, to protect the rights of each against the other. The Government should protect and not restrain freedom. Professor Dyer insisted that the law of supply and demand regulates the prices of commodities and services on the basis of their value, and also regulates the relative production in various fields. Profits and income on capital are regulated by natural laws in the same way that wages and commodity prices are regulated. When there is too much capital invested in any field, prices and dividends decline. In the case of a shortage, they advance.

In attacking the provision stipulating that the price of coal shall be fixed on a basis of fair wages to labor and fair return on capital, Professor Dyer said: "To fix prices so that every coal company could make a stipulated dividend, regardless of efficiency, on the capital invested would be the most stupid and unjust thing that could be done in regulating business. It would mean that the efficient would be docked and the inefficient rewarded." He said the bill would "repudiate the standard of value fixed by the law of demand and supply as applied to labor and coal mines and substitute a standard fixed by the needs of the employes, known as a fair wage." He insisted that the value of a commodity or of labor is what it will bring on an open market.

Legal Objections

Legal objections to the legislation were advanced by A. M. Belcher, of Charleston, on behalf of the West Virginia Coal Association. He pointed out that the proposal is "class legislation," as it does not affect other fuels which compete with coal. As the production of coal is not interstate commerce, Mr. Belcher argued that Congress can not legislate respecting its ownership, production or prices. He declared that the legislation is illegal because it is intended to restrict production and to increase prices. As there is a 40 percent overproduction in bituminous, he contended that there is no way to have those producing that surplus to give up their business without compensation, nor is there any way to require the producers of the 60 percent to purchase the property of those holding the 40 percent surplus. "The production of coal

is subject to the control of the state," said Mr. Belcher.

Senator Smith (Dem., S. C.) said the question whether coal is impressed with a public use is the crux of the matter. Senator Glenn said that if it is conceded that there is no public interest in the production of coal, the regulation would not apply. Senator Sackett (Rep., Ky.) admitted that decisions of the Supreme Court to the effect that coal mining is not impressed with a public interest answers the question as to the lack of control of Congress under the commerce clause, but not as to other powers of Congress to control the industry. The Senator thought Congress could control the industry in the interest of conservation to prevent wasteful mining methods.

Senator Smith said that if Congress could require West Virginia to produce coal if that state ordered the mines closed, it would result in compulsory production. The Senator said the aggregate coal deposits are owned by the public, but that the separate units are owned by individuals. When Senator Glenn stated that public utilities are restricted, Senator Couzens said they are public utilities. Senator Glenn did not think a proposed coal commission would act arbitrarily.

Mr. Belcher also contended that the proposed legislation would remove the power of the states to tax coal resources. When Mr. Belcher stated that if Congress can not, as decided by the courts, regulate wages in the District of Columbia, over which it exercises exclusive jurisdiction, it could not regulate wages and working conditions in the coal industry in the various states. Senator Glenn stated that acts had been passed restricting the rights of labor. Mr. Belcher stated that if those engaged in the industry can not work out its problem, it is difficult to see how inexperienced parties could improve conditions. He denied that the industry lacks leadership, but stated that it embraces as high a type of men as can be found in any field. Senator Glenn stated that criticism as to leadership was due to the failure of the industry to produce as satisfactory results as had been accomplished in other industries. Mr. Belcher stated that the public has not appreciated the problems under which the industry has operated, particularly in connection with strikes which had forced the opening of new mines, and contributing to overproduction in the industry.

Contention was made by Mr. Belcher that Congress can not fix the conditions under which coal is produced and its prices although the coal may be intended for interstate shipment. "If Congress has the power to regulate, restrict, or forbid coal from entering interstate commerce, it would have power to control all industry," said Mr. Belcher. "The bill violates the liberty of contract. The ultimate result of this legislation is to compel all men engaged in mining coal to become members of the union and encourages the breaking of private contracts with their employers."

Capt. Karl D. Loos, attorney, of Washington, D. C., of the law firm of Butler, Lamb, Foster and Pope, in behalf of the National Coal Association, argued against the constitutionality of the legislation, contending that it is beyond any Federal power to subject the mining of coal and the employer-employe relations in the industry to Federal control. The attorney contended that the Federal Government does not have absolute power to exclude coal from interstate commerce. The argument was advanced that coal is not impressed with a public service. Even if it was conceded that coal mining is affected with a public interest, Captain Loos stated that the right to regulate production would be in the state where the coal is produced and not in the Federal Government, because production is exclusively within the state jurisdiction. He declared that the power of Congress to enact the anti-trust laws to free interstate commerce from obstructions does not subject the mining of coal to Federal regulation any more than it does the business of any other person or corporation engaged in manufacturing or mining or in wholesale or retail trade or in other occupations. He quoted court decisions to the effect that the mining of coal is not interstate commerce and that to regulate and supervise its mining would be unconstitutional. "No power exists in Congress to regulate or control the mining of coal or employer-employe relations in the coal mining industry," said Captain Loos. "The only manner in which congressional power could be extended to these subjects is by constitutional amendment." The bill is unconstitutional because it attempts to fix the price of coal. Neither the state nor the Federal Government has the power to fix prices in a business which is not affected with a public interest. A legislative declaration can not establish the fact that a business is affected with a public interest. Even if it were affected with a public interest the regulation would be within the jurisdiction of the state in which the business is carried on. The bill is unconstitutional because it attempts to control contracts between employer and employe in an intrastate business." He quoted court decisions to the effect that the right of an employer and employe to make a contract with relation to membership or non-membership in unions is protected by the constitution and that neither the state nor Federal Government can affect that right. Even if this matter came under the police powers, the regulation of contracts relating to the mining of coal would be under the state and not the Federal Government.

Class Legislation

Captain Loos argued that the bill is unconstitutional because it is class legislation, setting up a limited exemption from the anti-trust law, applying only to bituminous mining. "Any modification of the anti-trust laws to permit or facilitate cooperative action of separate units should apply generally and not to a single industry," he said. "This subject is now under consideration by a number of organizations, including the American Bar Association. Doubtless proposals will soon be presented for general legislation, offering the opportunity for all industries to form marketing organizations."

Another objection to the legislation was that it failed to prescribe standards for the industry or the proposed coal commission. The legislation was also declared to be vague and indefinite, containing criminal punishment clauses without defining the crimes.

Captain Loos pointed out that there is existing Federal law affecting the bituminous industry. Sections of the transportation act give power to the Interstate Commerce Commission to control the interstate movement of bituminous and other commodities in an emergency, under which priority orders may be issued to govern the distribution of coal, and this authority has been upheld by the Supreme Court. Existing law authorizes the Department of Labor to mediate labor disputes on a voluntary basis.

Public Policy

E. L. Greever, attorney for the National Coal Association, said the legislation is out of harmony with the views of President Coolidge and President-elect Hoover, whom he quoted in opposition to Government ownership or control of industry. Mr. Greever declared the bill to be constitutionally and economically unsound. If the legislation was applied to coal it could equally apply to all other commodities, which would mean the projection of the Government into business in such a way as to destroy the rights of individuals. He declared the proposed legislation would reduce efficiency in the production of coal and result in its increased cost of production. Referring to recent strikes, which have resulted in non-union mines being able to meet the coal requirements of the country, Mr. Greever said: "The power of the strike to decrease production materially was ended." Mr. Greever stated that it is not easy for an industry to adapt itself to rapidly changing conditions as have been experienced by the bituminous industry. He declared that no justification exists for much of the criticism that has been leveled against coal producers. "They are probably as keen and resourceful business men as can be found in any industry," he said. "The progress they have made in mining methods, preparation of coal and in efficiency and economy can hardly be equalled. Whatever defects there may be in their sales policies and practices may be attributed to the competitive situation in which over-production has placed them. No Federal power can control or lessen competition. It can only be done by the industry. The only remedy is to reduce the pressure of excess productive capacity. There are two ways by which this may be brought about—by working out the problem by the industry under economic laws, or by some sort of drastic governmental intervention and control. A number in the industry are trying to solve their problems through association work, including trade practice standards and conferences with the Federal Trade Commission."

Trade Practices

Mr. Greever stated that officials of the association have taken up plans with that commission looking to adoption of uniform trade practices in the bitumi-

nous industry. Codes are in process of formation in Eastern Ohio, Illinois and Indiana and committees are studying the subject in the New River, Kanawha, Harlan, Southern Appalachian, Western Kentucky, Central Pennsylvania and other districts. Northwest dock operators have taken steps to bring about an agreement on fair trade practices.

F. M. Livezey, representing the State of West Virginia, said that state will not surrender its control over the mining of coal. He challenged the authority of the Government to authorize agreements under which the state would be dispossessed of its control.

Manufacturers Object

The National Association of Manufacturers through J. A. Emery and J. C. Gall filed a brief in opposition to the legislation, as did also the Wholesale Coal Trade Association.

Henry Warrum, for the miners' union, argued in support of the legislation, contending that as the Federal Government can impose an income tax on corporations created by a state it can regulate and license such corporation. "This bill deals exclusively with corporations engaged in shipping coal in interstate commerce and is predicated on the power of Congress to license and regulate such corporations," said Mr. Warrum. "It does not affect corporations that are engaged in simply mining coal, and does not regulate or license individuals engaged in either mining or shipping coal. There is abundant authority for Congress to license and regulate corporations created by a state which assume to exercise franchises and privileges under the national sovereignty." Answering the objection that the bill is class legislation, Mr. Warrum said the courts have upheld commodity classifications, as in the case of the Pennsylvania tax on anthracite. Mr. Warrum declared that the bituminous industry "occupies an isolated position peculiar to itself; its capital structure is being destroyed; its labor wage shamefully deflated; it is the scene of violent labor disputes; the victim of unprecedented cut-throat competition; the cringing prey of railroads and public utilities, and is wasting 40 percent of the coal it mines."

Mr. Warrum declared that as Congress has control over the subject of pools, mergers and combinations it can meet the situation in the bituminous industry by granting privileges for the purpose of limiting competition with appropriate conditions. He declared that the bill does not pretend to regulate prices in a state unless the corporation desires to merge with other corporations. If a corporation has mines in different fields it could join separate marketing pools without having uniform prices. As to the labor provisions Mr. Warrum said they do not require the miners to join a union. "They can have a company union, act through committees; or deal individually with their employer," he said. "There is nothing in the bill that impairs the obligation of contract or prevents the making of individual contracts. Individual contracts can be terminated at will. A corporation may employ only non-union miners, but it has no right to require the miner to agree that he can not quit his service and join a union. The requirements that the miners be paid in lawful money, be free to purchase their necessities where they choose, be entitled to select a checkweighman and to have the scales inspected by a Government official are constitutional rights of the miners. They do not deprive any corporation of any of its rights. They protect mine labor from exploitation by token money, company stores and false weights."

Mine Permits

Mr. Warrum denied that the bill would destroy interstate commerce or eliminate 40 percent of the production of bituminous. Referring to the provision requiring approval by the proposed coal commission of railroad lines to mines, Mr. Warrum said "permission should be granted in all proper cases and refused in cases that would contribute to waste and disorder in the industry. The limitation on production would follow the general stabilizing of the industry."

Mr. Warrum argued that Congress has the right to license and regulate corporations engaged in mining and shipping coal in interstate commerce. "The ruling law upon the subject undoubtedly is that the mining of coal when considered in connection with its shipment in interstate commerce is a subject upon which Congress may legislate and has legislated," said Mr. Warrum. In stating that the Government, either through Congress or the courts, is able to correct or restrain labor employed at mines under the anti-trust act in injunctions growing out of strikes, Mr. Warrum said: "If Congress may legislate with reference to this labor it must have power to deal with the subject fully in order to deal with it fairly."

The brief of the National Association of Manufacturers said that if the legislation is constitutional Congress could regulate any commodity by a threatened denial of the facilities of interstate commerce. Objection to the bill was based on the ground that it would deprive corporations of their right to ship coal if they will not submit to the conditions imposed, which would also deprive consumers of their supplies. It was said that the fact that any industry may be impressed with a public interest has no relation to the question of whether congressional power may be exercised over it. The point was made that production is not commerce, subject to congressional power. It was contended that Congress may not regulate production under the guise of regulating commerce. Argument was also made that Congress does not have jurisdiction over contracts between those engaged in the local operation of mining coal and their employes.

Hearings End

Attorney T. C. Townsend, for the miners union, argued in favor of the bill. Senator Couzens will confer with Senator Watson with a view of appointing a subcommittee to digest the evidence and to draft, if possible, proposed legislation to stabilize the bituminous industry, which will meet the views of all members of the committee. Senator Hawes (Dem., Mo.), said the union bill had no chance of getting before the Senate and suggested that as in the case of recent railroad legislation, the operators and miners get together on a measure. Attorney Townsend asked that the bill be reported to the Senate but Mr. Hawes said there is no hope for such action as the measure is too crude. Mr. Townsend suggested three amendments during his argument. Mr. Townsend suggested that the legislation be considered at the next session along with tariff revision and agriculture relief. Senator Couzens suggested agreement by operators and miners on proposed legislation but Mr. Townsend thought this would be difficult. The Michigan Senator thought the proposed commission should have authority to require certain data affecting the industry instead of making this action by it permissive. Senator Hawes said the consideration of the legislation up to this point was of a pioneering nature. Mr. Townsend stated that Congress could regulate the industry from the standpoint of conservation on the basis of the Supreme Court decision upholding the suit of Pennsylvania against a law of West Virginia forbidding interstate shipment of natural gas. Senator Hawes developed the fact that most of the states forbid the payment of wages by scrip. Mr. Townsend was not sure whether West Virginia expressly prohibits scrip payment. Senator Glenn in stating that there had been payroll robberies in Illinois mines, suggested that miners be paid by check, and Mr. Townsend and John L. Lewis, head of the union, said there was no objection if facilities are provided for cashing them and that such arrangements are being made by many companies. Mr. Townsend stated that it would take several years for the proposed coal commission to function, and referred to the fact that it was 15 years before the Interstate Commerce Commission had operated satisfactorily. Senator Wheeler suggested that the bill provide a minimum price for coal, but Mr. Townsend did not think this could be regulated as some operators might undersell. Mr. Townsend said the bill would take from the middleman the profit between the mines and the dealers and give it to the operators. Senator Black said that if the labor provisions as proposed for coal were good they should be applied to all industries. Mr. Townsend said similar legislation was being considered by the Senate Judiciary Committee.

Mr. Townsend argued that if the Government has the right to tax a corporation it has an equal right to license and regulate it. The attorney argued that if Congress should treat coal as stamped with a public use and subject it to the interstate commerce clause it would not go further than the Supreme Court has said that it could go in connection with the livestock industry. "The coal business is no more a private business than that of farming," said Mr. Townsend. "Government aid and encouragement to business amounts to the same thing, whether it comes as a result of tariff laws, rate fixing or in the manner provided by this bill."

ANTHRACITE *and* BITUMINOUS COAL *in* 1928

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Bituminous Situation Reviewed by E. C. Mahan

The production of bituminous coal in 1928, amounting in round numbers to 490,000,000 net tons, was about 27,000,000 tons below the output of 1927, according to President E. C. Mahan, of the National Coal Association. The difference is partially offset by the fact that in 1928 a considerable amount was withdrawn from stocks for current consumption. Exports during the first 10 months of 1928 were about four million tons less than the 1927 figure, for the corresponding period, which indicates that the consumption figure for 1928 is very close to the 1927 mark.

"For the four markets for which we have separate statistics," says Mr. Mahan, "three, namely, New England, Canada and overseas exports, showed declines with New England in the lead, for which varying reasons might be given, such as unusual stocks, industrial depression and competitors' activity. On the other hand, shipments to the markets reached by means of the Great Lakes, show a noteworthy increase over those of the previous year in spite of the fact that Lake shipments in 1927 set a new record and that bituminous coal on the docks at the head of the Lakes on January 1, 1928, was in excess of the stocks of any previous January 1. A part of this increase is doubtless due to the replacement of anthracite, shipments of which up the Lake have declined notably during the last two years. After due allowance for such substitution, however, there remains a noteworthy increase in bituminous shipments, part of which may be attributed to the growing industrial activity of that section of the country and part to a temporary falling off of all rail coal into that region.

"The strike of the mine workers, inaugurated on April 1, 1927, is, for all practical purposes, at an end. The failure of the strike, even in its early days, to cause any interruption in the supply of bituminous coal shows that the country can now count absolutely upon an uninterrupted supply of its chief industrial fuel. There is no longer any relationship of fixed differentials between the scales in different union fields, each field that has signed up with the Union having made its own terms independently. The Central Competitive Field, as a wage rate-making body, is a thing of the past. Finally, the mine capacity of the country operating under union agreements represents but a small percentage of the total, probably not over 20 percent. The danger of a nation-wide strike in coal is therefore at a minimum.

"To expand our export trade in coal, the Shipping Board, using an appropriation of the last Congress, has already conditioned a number of vessels for carrying coal in export trade and plans further work along the same line. Stable rates over a considerable period make it possible for the first time for American exporters to figure on the cost of ocean transportation and so enter into term contracts with foreign purchasers. A considerable amount of coal has already been contracted for and vessels chartered for conveying it. If this provision of the Shipping Board is supplemented by the establishment of a reasonable through rate on export coal from the mine mouth to the foreign market, we may hope to see a substantial foreign trade develop in the near future."

E. W. Parker Reviews Anthracite Situation

According to the estimates of the United States Bureau of Mines, the production of anthracite for the first 11 months in 1928, including local sales and the coal used for power at the mines, was approximately 63,215,000 gross tons, as compared with 66,887,000 gross tons for the corresponding period in 1927, indicating a decrease this year compared with last of 3,672,000 tons. The shipments of anthracite for the month of December, 1928, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 4,844,050 gross tons, making the total of approximately 68,000,000. This includes local sales and coal used for power at the mines.

Edward W. Parker, director of the Anthracite Bureau of Information, reviews the situation in 1928 as follows:

"It is not unreasonable to anticipate that when the record for the coal year (beginning April 1, 1928, and ending March 31, 1929) shall have been completed, it will show a tonnage equal to that of the preceding coal year. With normal conditions prevailing, the production for the first three months of 1929 should exceed by no less than 3,000,000 gross tons the tonnage for the first quarters of 1927 and 1928. If, however, mild winters are to continue to prevail and to represent "normalcy" in the records of the weather bureau, the writer's anticipation for the coming winter will be found decidedly wanting.

"It is now generally accepted that weather conditions, not the substitution of oil or other fuels, have been and will continue to be for some time at least, the principal factor governing the production of anthracite. Much has been said about the loss of markets in New England and other distant markets due primarily to the strikes in 1922 and 1925, and the inroads made by substitute fuels. That New England is returning to its old love is shown by the fact that up to November 24 of 1928, the number of cars passing the New England gateways was 142,132, as compared with 134,310 cars in the same period of 1927. Unquestionably, the resentment in New England over the anthracite tonnage tax still exists, and encourages the use of Welsh and Scotch anthracite, German ovoids, and other foreign fuels which are being imported in no inconsiderable quantities, as well as 'smokeless' domestic coal and fuel oil.

"Shipments to Canada, which northerly neighbor takes 99 percent of the anthracite exports, show similar recovery. In the three months of August, September, and October the exports to Canada were, in 1927, 865,305 gross tons; in 1928, 939,668 tons. An exception is to be noted in the anthracite trade in the Northwestern territory, where the high cost of anthracite, coupled with high transportation and handling expenses, has caused the continuance of the use of other fuels forced upon that territory by Government action during the World War. Such action was necessary at that time, but its aftermath has been more difficult to overcome than has been the effect of the strikes of 1922 and 1925 on the New England market.

"An apparently increasing disturbing factor in the distribution of anthracite, though not necessarily affecting the total production and consumption, is the extension of hand-to-mouth buying. Those with limited storage capacity do not lend themselves to provisioning for the season, and even in the case of separate dwellings ease of delivery of commodities as wanted makes storage of supplies unnecessary, while meeting the 'easy monthly payments' on radios, electric washing machines, electric refrigerators, and other household conveniences, not to mention the family 'car,' have so mortgaged the incomes of thousands of families of moderate means that the numbers of those formerly accustomed to follow the excellent example of Solomon's ant and lay in their entire winter coal supplies in the summer months have been attenuated to a degree hardly realizable by any but the coal dealer. Consequently, domestic distribution of anthracite during the summer months has been much reduced as compared with former years, and every noticeable drop in the temperature since the arrival of supposedly coal-burning weather has been marked by insistent demands upon the dealer for a ton or two of coal, and his five-, six-, or eight-ton trucks that might have been used economically in delivering their capacity loads in the summer months are forced to uneconomical use in delivering the smaller quantities. In a recent report to the United States Department of Commerce the correspondent of that Department at Boston, says:

" 'Among the collective activities of the industry, looking to advanced service to the public, and which may be included in the outstanding developments during the past year, are the establishment of a traffic bureau, the extension of the Anthracite Coal Service, and the institution of mechanical research aimed at improved methods of combustion, heat control, and ash handling.' "

Minnesota Legislature May Reduce Iron Ore Taxes

Legislation to relieve the taxation burden now resting on the iron ore industry of Minnesota during the present session of the State legislature is held to be likely.

Reduction of the royalty tax on mining property from 6 to 4 percent is proposed in a measure introduced in the Minnesota House of Representatives by Representatives E. P. Scallon of Crosby; R. W. Hitchcock, Hibbing; J. E. Merrit of Aitkin, and 13 others. The reduction, under the terms of the bill, would become effective January 3, 1930.

The same authors also introduced a bill to reduce the occupation tax on iron ore from 6 to 4 percent, effective at the same date as the royalty tax.

The Minnesota tax commission, reporting to the legislature on its position regarding the taxation on the iron mining industry in the state, has not changed its attitude in the last eight years. In its 1920 report it advocated the reduction of the classification for ad valorem valuation from 50 percent to 33 1-3 percent on iron ore and assurance of some kind by the state governing bodies that the taxation method shall be more permanent.

The commission in its report eight years later and released for publication recently, quotes extensively from its 1920 report and declares: "The commission still adheres to the opinions expressed in the foregoing excerpts from our report of 1920. Eight years of additional experience with the taxation of mines and minerals has but served to confirm our former conclusions. The predictions of the effect that excessive taxation would have on the mining industry of the state, and particularly on the development of our immense tonnages of low-grade ore, have unfortunately been fully realized."

The tax charge on iron ore mining in the state is greater than the labor charge for mining the ore, according to the tax commission. According to the 1926 report of the commission the total taxes on iron ore was $21,732,333.10, while the labor cost for the removal of 39,580,850 tons of ore mined was $14,731,693. This the operators stress.

The county auditors of Minnesota, in annual convention recently, declared unanimously in favor of the recommendation of the state tax commission.

The United States Supreme Court early in January declined the request of the Vermilion and the Crete Mining companies and the Inland Steel Company for reconsideration of its recent dismissal of their appeals brought to contest the validity of the royalty tax law as construed by the lower courts.

ARIZONA CHAPTER OF MINING CONGRESS RE-ELECTS OFFICERS

All officers and directors of the Arizona chapter of the American Mining Congress were re-elected without exception at a meeting recently held in Phoenix. The officers who will retain their positions in the chapter are H. A. Clark, general manager, Calumet & Arizona Mining, governor; C. A. Smith, general manager, Ray branch of Nevada Consolidated Copper, first vice-governor; Thomas H. O'Brien, general manager, Inspiration Consolidated Copper, second vice-governor; and W. B. Gohring, of Phoenix, secretary.

Directors re-elected were Frank Ayer, I. H. Barkdoll, P. G. Beckett, W. S. Boyd, H. A. Clark, M. Curley, W. Val DeCamp, J. P. Hodgson, William Koerner, Julius Kruttschnitt, Jr., F. W. MacLennan, T. O. McGrath, Thomas H. O'Brien, C. A. Smith, R. E. Tally, and F. A. Woodward.

Anaconda Reopens Mountain View Mine

The Mountain View Mine of the Anaconda Copper Mining Company at Butte, Montana, was reopened the latter part of January with a crew of approximately 600 men.

The Anaconda company, during the past three months, has announced the opening of four of Butte's largest mines. These are the Badger State, the Steward, the Original and the Mountain View. These mines mean a total increase in the daily employment list of about 2,700 men.

Colorado Mining Association and American Mining Congress Chapter Meet

Hundreds of miners gathered in Denver January 16th for the 16th annual meeting of the Colorado Mining Association and the Colorado Chapter of the American Mining Congress.

Five addresses were given the opening day. John T. Joyce spoke on "Mining Resources of Colorado"; William R. Eaton, "Gold Standard"; Fred Farrar, "Compensation Insurance"; Charles A. Chase, "Metal Mining Conditions in Colorado"; Sidney J. Keoughan, "The Petroleum Industry of Colorado."

At the morning session of January 17, Dr. G. F. Loughlin and B. S. Butler of the United States Geological Survey, delivered addresses touching upon the cooperation between the Survey and the State of Colorado in topographic mapping and geological studies, and how this work had been of direct benefit to the Colorado operators. Dr. E. U. von Buelow spoke on "The Application of Geophysics in Locating Ore Bodies in Colorado."

The main discussion at the session of January 17th centered on the proposal of an electrolytic zinc plant for Denver for treatment of such ores as now are shipped to other states. William E. Greenwalt, Thomas Patterson Campbell and E. W. Keith dealt with various phases of this subject.

Thursday night, January 17th, the convention closed with the annual sowbelly dinner in the Hall of Colorado at the Cosmopolitan Hotel.

J. O. A. Carper, the "father of the sowbelly dinner," presided as toastmaster and at the speakers' table were F. G. Bonfils, publisher of *The Denver Post;* Dr. Charles A. Lory, president of the Colorado Agricultural college; Dr. C. F. Coolbaugh, president of the School of Mines; Jesse F. McDonald, R. J. Walter, William C. Russell, Judge H. L. Shattuck, John T. Joyce, Volney Hoggatt and several mining engineers.

Mr. Carper read a number of telegrams received from President Coolidge, President-elect Hoover, Secretary Roy O. West of the Department of the Interior,

the Senators and Congressmen of Colorado and from many men in various parts of the United States whose names are well known to the mining world.

Approximately 700 attended this banquet, now regarded as something of an institution in mining circles.

Commerce Company Largest Zinc-Lead Shipper in Tri-State District

The Commerce Mining and Royalty Company finished 1928 at the head of the zinc and lead ore shippers of the Tri-State District for the second consecutive year, according to the Joplin Globe. Its lead over the remainder of the field in both lead and zinc shipments was considerably larger than in the previous year. The Commerce shipped 56,381 tons of zinc and 12,267 tons of lead during 1928, as compared with 48,802 tons of zinc and 10,443 tons of lead in 1927.

The Federal Mining and Smelting Company, which led the zinc shippers in 1924, 1925 and 1926, but which fell to third place last year, was the second largest zinc shippers of 1928, with 41,549 tons to its credit. In 1927 the Federal shipped 45,592 tons of ore.

The Eagle-Picher Lead Company finished third in the list this year with 32,551 tons of zinc to its credit. In 1927 the company was second when it shipped 47,587 tons of ore.

Fourth and fifth places in the zinc standing went to the Consolidated Lead and Zinc Company and the Evans-Wallower Lead Company. The Consolidated shipped 29,714 tons of concentrates as compared with 33,528 tons in 1927, while the Evans-Wallower delivered 29,560 tons, as compared with 46,353 tons in the preceding year.

The Century Zinc Company was second among the lead shippers, with 8,802 tons of lead reported. The company was sixth among the zinc shippers.

The Evans-Wallower company finished third among the lead shippers.

Option Tri-State Properties

Articles of incorporation for the Canam Metals, Ltd., have been filed by J. K. Quinn and associates, who have an option on the properties of the Childress Lead and Zinc Company, located in the Tri-State district, and on prospects in Canada. The capitalization of the company is 3,000,000 shares of no par value, of which 1,850,000 shares have been issued for properties and to provide finances.

The company has an option on the Childress properties, including the Fox, Fort Worth, Northern, Southside and White Bird mines.

In Canada the Canam owns the Jefferson claims near Rush Lake, in the Sudbury district of Ontario. The company is also negotiating for properties in Manitoba and elsewhere.

Directors of the company are J. K. Quinn, R. S. Archibald, Joseph Errington, Frank P. Book and A. J. McComber. It is understood that application to list Canam shares on the stock exchanges in the United States and Canada will be made soon.

Silver Suit May Be Tried in March

Argument is expected to be heard early in March by the Court of Appeals of the District of Columbia in the suit of the American Silver Producers Association to require the government to purchase 15,000,000 ounces of silver at $1 per ounce under the Pittman act.

Iron Ore Explorations

Exploration developments for a possible new iron range are reported under way on about 50,000 acres acquired by great Northern Iron Ore properties, chiefly in Aitkin County, Minn., between the Mesaba and Cuyuna ranges. The new property is about 65 miles from the Duluth harbor, where ore is loaded for shipment down the Great Lakes.

Century Zinc Company Sinking Shafts

Two shafts have been started on the 300-acre Scott lease of the Century Zinc Company, east of Hockersville, on the Oklahoma side of the Kansas-Oklahoma state line, S. H. Davis, manager, has announced.

More than 300 drill holes have been put down on this tract in the last several years by the Century Company, and a large body of ore developed. More than 1,000,000 tons of commercial ore have been blocked out, it is estimated.

A mill, located on one of the other leases of the company, will be moved to the Scott tract soon as the development work has progressed.

GOLD, SILVER, COPPER, LEAD, AND ZINC MINED IN COLORADO IN 1928

In terms of recovered or recoverable metals. (Advance figures by C. W. Henderson, United States Bureau of Mines)

County	Gold *	Silver *		Copper		Lead		Zinc		Total value
	Value	Fine ozs.	Value	Pounds	Value	Pounds	Value	Pounds	Value	
Adams	$4,755	34	$20	.....	.....	.....	.....	.....	.....	$4,775
Boulder	93,891	45,227	26,458	5,000	$730	143,000	$8,723	.....	.....	129,802
Chaffee	413	286	167	.....	.....	22,000	1,342	.....	.....	1,922
Clear Creek	33,860	140,004	81,902	30,000	4,380	476,000	29,036	60,000	$3,600	152,778
Custer	41	1,240	725	.....	.....	35,000	2,135	.....	.....	2,901
Dolores	22,636	364,130	213,016	787,000	114,902	8,902,000	543,022	9,313,000	558,780	1,452,356
Douglas	310	.....	.....	.....	.....	.....	.....	.....	.....	310
Eagle	10,212	186,037	108,832	1,000,000	146,000	.....	.....	.....	.....	265,044
Gilpin	53,106	3,344	1,956	6,000	876	24,000	1,464	.....	.....	57,402
Gunnison	5,602	18,706	10,943	3,000	438	730,000	44,530	768,000	46,080	107,593
Hinsdale	21	1,117	653	1,000	146	11,000	671	.....	.....	1,491
Jefferson	103	1	1	.....	.....	.....	.....	.....	.....	104
Lake	196,589	495,660	289,961	270,000	39,420	10,947,000	667,767	28,638,000	1,718,280	2,912,017
La Plata	48,910	21,679	12,682	.....	.....	51,000	3,111	.....	.....	64,703
Mineral	434	188,461	110,250	.....	.....	20,000	1,220	.....	.....	111,904
Moffat	207	1	1	.....	.....	.....	.....	.....	.....	208
Ouray	214,987	93,238	54,544	332,000	48,472	98,000	5,978	.....	.....	323,981
Park	283,142	8,554	5,004	5,000	730	173,000	10,553	.....	.....	299,429
Pitkin	21	89,670	52,457	.....	.....	1,495,000	91,195	.....	.....	143,673
Rio Grande	221,147	455	266	.....	.....	.....	.....	.....	.....	221,413
Saguache	23,339	896,776	524,614	3,796,000	554,216	4,375,000	266,875	.....	.....	1,369,044
San Juan	327,545	820,154	479,790	1,775,000	259,150	18,271,000	1,114,531	23,116,000	1,386,960	3,567,976
San Miguel	531,142	695,957	407,135	108,000	15,768	6,832,000	416,752	.....	.....	1,370,797
Summit	72,662	29,801	17,434	1,000	146	1,431,000	87,291	3,308,000	198,480	376,013
Teller	3,098,212	30,933	18,096	.....	.....	.....	.....	.....	.....	3,116,308
Total, 1928	$5,243,287	4,131,465	$2,416,907	8,119,000	$1,185,374	54,036,000	$3,296,196	65,203,000	$3,912,180	† $16,053,944
Total, 1927	5,279,118	3,784,605	2,145,871	5,670,581	742,846	66,772,557	4,206,671	71,729,000	4,590,656	‡ 16,965,162
Increase/dec'se from '27.	—$35,831	+346,860	+$271,036	+2,448,419	+$442,528	—12,736,557	—$910,475	—6,526,000	—$678,476	—$911,218

* Includes placer production. †Average value of metals, 1928: Gold, $20.671835 per ounce; silver, $0.585 per ounce; copper, $0.146 per pound; lead, $0.061 per pound; zinc, $0.06 per pound. ‡Average value of metals, 1927: Gold, $20.671835 per ounce; silver, $0.567 per ounce; copper, $0.131 per pound; lead, $0.063 per pound; zinc, $0.064 per pound.

Research at Michigan College of Mining and Technology

Research conducted by the Michigan College of Mining and Technology, with state aid, has resulted in application of great importance to the copper mining industry, and work under way, it is believed, will result in additional value to both the copper and iron districts. The work is being carried on in all of the technical departments of the college, and is now in its second year. For the first year of the present biennium, $25,000 was available from the state, and for the second fiscal year a total expenditure of $50,000 was authorized.

The conduct of this research has served to bring the members of the college staff in close contact with the operations of the mineral industry in copper and iron, and has also brought to the college outside experts, who have been the source of much inspiration both to the faculty and students. It has been productive of great enthusiasm both in research and class work.

The most important result to date has been the successful application of modern flotation methods to the concentration of Michigan amygdaloid copper ore. This method has now been installed in all of the mills in the district, and from such information as is available is resulting in saving from nearly 2 to over 4 pounds of copper per ton of ore treated.

Studies now are being made of ore concentrating machinery to improve the mechanical operation of apparatus developed for the separation of minerals on the basis of their color. In this method the light reflecting properties of minerals is the basis. It has been highly successful as a laboratory method.

Solutions of copper are being studied with a view to learning more in regard to the fundamental chemistry of this metal. Another line of research has had to do with the checking of present methods of determining copper analytically and the development of a new method. A third line of work is related to the physical chemistry of the corrosion of copper. A fourth line relates to the underfacial tension between various minerals and liquids to obtain new fundamental physico-chemical information that can be applied later in the study of various processes of ore concentration.

Much work has been done in studying the effect of impurities in copper on the conductivity and other physical properties. This work has been done with the purpose of finding ways to improve the quality of the copper produced in Michigan.

The college is cooperating with the Michigan State Geological Survey and work is under way which will add extremely important new knowledge to the geology of copper and iron deposits. Detailed magnetic surveys are adding much new information relating to the structure of the rocks in the copper and iron districts.

A study is being made of the low grade iron ores of Michigan, looking toward the development of practicable methods of concentration, so that the Michigan iron mining industry may be conducted after the known supply of merchantable iron ore is exhausted. The first purpose of the iron ore study is to determine the characteristics of the various types of low grade iron ores to provide information on which to consider the possible application of various methods of concentration. One of the important phases of this preliminary work is the determination of the amount of these various type of low grade ores.

Work has been conducted in the study of the sulphur in iron ores in an endeavor to find some possible commercial methods of eliminating at least a portion of it.

Important work has been done in cooperation with the terrestrial magnetism laboratory of the Carnegie Institution of Washington. An electrical resistivity method for the approximate determination of the depth of glacial drift and for the determination of the location of black slate horizons in the Menominee iron district has been tried out to some degree, and indications are that something of much use to the industry may develop from further study of this method.

Some work has been done in the use of

New York Tribune

Mr. Hoover selects a piece of material

Fairmont (W. Va.) Times

Tex Rickard was good but he didn't stage anything like this

the seismograph in determining geological facts in areas where the rocks are obscured by glacial drifts.

The geophone apparatus developed by the army for detecting military mapping operations, and also that developed by the navy for sounding purposes, are being used in research to find what underground conditions can be detected by these instruments.

An intensive study of the magnetic properties of geological formations is under way, and while it is too early to predict anything with regard to the outcome, the subject is a fundamental one which should result in valuable information. In this work the preliminary stages have related quite largely to the development of instruments and methods.

Anaconda Capital May Be Doubled

Directors of the Anaconda Copper Mining Company have announced an offer to acquire the outstanding minority stock of the Chile Copper Company at 73 shares of Anaconda for 100 shares of Chile.

At the same time the capital stock of Anaconda will be increased from 6,000,000 to 12,000,000 shares.

Directors of the Chile Copper Company have announced the declaration of a quarterly dividend of 87½ cents, placing the stock on a $3.50 annual basis. The stock was advanced to $3 basis in October.

A special meeting of stockholders of Anaconda has been called for March 14 to consider the proposal to increase the capital stock. The present capital of $300,000,000, divided into 5,000,000 shares of $50 par shares, will be increased to $600,000,000 divided into 12,000,000 shares of $50 par.

New Metal Exchange Proving Its Value

The National Metal Exchange, although only little more than a month old, has already proved its value to the metal industry, according to Erwin Vogelsang, president, who reported on its activities at the first annual meeting of the exchange held recently.

"Up to December 31, in 24 days of trading, contracts representing close to one-twelfth of the amount of tin delivered into consumption in the United States in 1927 changed hands on the exchange," Vogelsang said. "This is a record for a new exchange of which our membership may well feel proud, and it is full of promise for the future."

Central Agency to Sell Zinc in Tri-State Field

Definite announcement of the establishment of a central sales agency for the disposal of zinc concentrates produced in the Tri-State district was made January 23 by R. C. Allen, of Cleveland, Ohio, vice president of Oglebay, Norton and Company, producers of iron ore in the Lake Superior district and sales agents for iron ore, coal, coke, fluorspar and ferromanganese.

Fourteen companies, producing approximately 300,000 tons of concentrates a year, have signed contracts with Mr. Allen to handle their product.

Although no announcement was made as to the companies involved in the agency, it is said that the Commerce Mining and Royalty Company, Interstate Zinc and Lead Company, Eagle-Picher Lead Company, Velie Mining Corporation, Lawyers Mining Company and the American Zinc, Lead and Smelting Company are some of the major producers who have aligned themselves with the agency.

According to the contract, Allen becomes the sole and exclusive agent for the contracting parties. The contract provides, however, that the operator reserves the right to make his own sales, but must pay the stipulated commission. The contract runs for a period of three years, beginning February 1, 1929. The operator agrees to pay ¾ of 1 percent of the selling price for compensation, which, on the present basis price of $40 a ton, is 30 cents a ton.

The contract provides that an office shall be located in or near Picher, but pending acquisition of suitable quarters an office may be located in Joplin or Baxter Springs.

The sales agency plan has been a subject of discussion for the past five years, or ever since Mr. Allen came to the field to act in advisory capacity in the formation of the Tri-State Zinc and Lead Ore Producers' Association. It was not until a year ago, however, that the plan was given active attention, and since then he has been actively interested in obtaining a sufficient tonnage to justify the establishment of an agency.

Zinc Freight Rates to be Investigated

A general investigation on freight rates of zinc will be made by the Interstate Commerce Commission, according to a recent announcement. Suggestions were invited by the commission from all interested parties as to what the scope of the proceeding should be before the order of investigation is drawn. It was requested that suggestions be submitted to the commission not later than January 31.

Commerce Mining and Royalty Company Building New Mill

Piers for a new mill to be built on the Paxson lease of the Commerce Mining and Royalty Company are being constructed. The mill, to be of steel construction, will be one of the largest in the Tri-State district, probably of 100 tons an hour capacity. The Paxson lease is about two miles west of Baxter Springs, Kans.

A large amount of drilling and prospecting has been done on the Paxson lease during the past few years. Two shafts have been sunk on the lease to the water level, which is about the 310-ft. level.

The Commerce Company has also drilled in a number of good holes on the Swalley lease, adjoining the Swalley lease of the Velie Mines Company, and a shaft is being sunk.

Canada's Mineral Production in 1928

In 1928, for the third year in succession, Canada's mineral production reached a new high record, when the value of the output was $271,000,000, marking a gain of nearly 10 percent, or $23,644,000 over the total for the preceding year, according to the official estimate compiled by Mr. S. J. Cook, chief of the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics at Ottawa.

Advances were general in all fields—metals, non-metals and structural materials. New output records were established for cadmium, copper, gold, lead and zinc among the metals; cement, coal, gypsum, lime, salt, sand and gravel, and stone in the non-metals and structural materials field; new output record values for natural gas, petroleum, and talc and soapstone were also reached.

Metals made magnificent advances, despite prevailing lower prices for lead and zinc. Improvement in prices of silver and copper helped to augment the total values for these metals. A gain of nearly $15,000,000 was noted in the total for the metals group.

Cadmium, produced at Trail during 1928, was a newcomer among Canada's mineral products.

Copper at 191,944,000 pounds, or nearly 96,000 tons, showed a gain of more than one-third over the total for 1927. One-half of the output was produced by British Columbia; about one-third by Ontario and one-sixth by Quebec.

Gold at 1,869,548 fine ounces showed a slight gain over the total for 1927. Porcupine mines produced more than 971,000 ounces and Kirkland Lake added 595,000 ounces; these, with gold from other sources, gave Ontario 1,572,000

ounces for the year. British Columbia produced 188,000 ounces; Quebec, 59,000 ounces; the Yukon, 32,000 ounces; Manitoba, nearly 17,000 ounces; the remainder was from Nova Scotia.

Lead production was 336,391,000 pounds, valued at $15,484,000, showing increased tonnage with a lower aggregate value due to the drop in prices. British Columbia mined 95 percent of the total lead produced by Canada during 1928; the remaining 5 percent was produced in about equal quantities from the mines of Ontario, Quebec and the Yukon.

Zinc, produced at Trail in British Columbia, and at the Tetreault mines at Notre Dame des Anges in Quebec, amounted to 183,823,520 pounds, valued at $10,089,000, which figures, as do those for lead, reflect growth in tonnage and decline in prices. The average price for the year in London was 5.488 cents a pound as compared with 6.194 cents in 1927.

Fuels, comprising coal, natural gas and crude petroleum, rose about $2,000,000 in value to $73,420,000.

Other non-metals, including a long list of which some of the chief items were asbestos, feldspar, gypsum, magnesite, pyrites, quartz, salt, talc and soapstone, were valued at $17,450,000, or about the same total as in the preceding year.

Coal tonnage was greater than in any previous year; 17,785,000 tons were produced at a value of $63,000,000. Little change was noted in the Nova Scotia tonnage or in the figures for New Brunswick and Saskatchewan. Alberta and British Columbia showed very considerable increases in tonnage as compared with the totals for the previous year.

Canada's mineral industry, third in importance among the primary industries of the Dominion, being surpassed in output value only by the great basic industries of agriculture and forestry, brings to the nation a prestige far beyond the monetary measure of the mineral output. First in nickel, first in asbestos, second in cobalt, third in gold, third in silver, fourth in lead and copper, and sixth in zinc among the world's producers, Canada presently enjoys an enviable position in the mining world.

Webb Mine in Minnesota May Be Reopened

Unconfirmed reports from Hibbing, Minn., state that the Webb mine, underground property of the Shenango Furnace Company, which has been closed for several months, will be reopened shortly.

The Webb mine was one of the largest independent underground properties in the Hibbing district and has employed in excess of 100 men. In 1925 the property shipped 416,000 tons of ore. The shipments to date exceed 2,000,000 tons.

As we go to press, we learn of the sudden death of Col. W. H. Sullivan, of Bogalusa, La.

Colonel Sullivan was a member of the Board of Governors of the Southern Division of the American Mining Congress, and not only the organization but the entire South suffers a great loss.

Born in Canada 64 years ago, Colonel Sullivan came to southern Louisiana in 1907 and located the town of Bogalusa as the site for the headquarters of the Southern Lumber Company and the Mississippi Southern Railroad, of both of which he was vice president and general manager.

He was mayor of Bogalusa from the time of its incorporation and for many years was a factor in the lumber industry.

"The Bridges of Pittsburgh"

Joseph White, Engineer of the Department of Public Works, Allegheny County, Pennsylvania, and M. W. von Bernewitz, Mining and Metallurgical Engineer of the United States Bureau of Mines, are the authors of an interesting book recently published entitled, "The Bridges of Pittsburgh." Its 110 pages are excellently illustrated with photographs pertinent to the subject. It is interesting to note that there are 43 bridges in Pittsburgh proper and more than 500 in the Pittsburgh district. Published by Cramer Printing & Publishing Co., Pittsburgh. Price, $5.

The Idaho Bureau of Mines and Geology has issued a report on silver ore deposits of the Pend Oreille district.

Personal Items

By the unanimous vote of representatives of the anthracite operating interests in the Schuylkill field, at meeting held in the offices of the Philadelphia and Reading Coal and Iron Company, at Philadelphia, on January 18, J. R. Sharp, general manager of the Philadelphia and Reading Coal and Iron Company, Pottsville, was chosen member of the Board of Conciliation to succeed J. B. Hadesty, resigned. Mr. Sharp, who was formerly general superintendent of the Mahanoy Division, recently succeeded Mr. Hadesty as general manager of that company.

Boyd Osler, former Hazleton mining man who was with the Hazle Brook Coal Co., in Hazleton, Pa., for a number of years and who is at present general manager of the Shamokin Coal Company, at Shamokin, is to succeed General Manager John W. Crooks when the latter retires from the firm of Pardee Bros. and Co., Inc., at Lattimer, Pa., February 1.

C. E. Sharpless of Ebensburg, Pa., announces the opening of an office in that town as Consulting Coal Mining and Efficiency Engineer. Mr. Sharpless for many years has served large coal companies in Pennsylvania and West Virginia as Chief Engineer and Superintendent. He is at present engaged in opening a new mine comprising approximately 1,700 acres of bituminous coal in West Virginia, for a concern in Philadelphia, Pa.

Samuel D. Warriner, president of the Anthracite Operators' Conference, has recommended to Dr. William R. Buckley, president of the Anthracite Cooperative Association, that the vice president of the Lehigh and Wilkes-Barre Coal Company, Charles Ash of Kingston, should be named as the new director for the operators' division of the association.

H. T. Wilson, president of the Pittsburgh Terminal Coal Company, Pittsburgh, Pa., has been elected president of The Collieries Company, Prentiss, W. Va., the reorganized company that has taken over the No. 4, or Prentiss mine of the defunct Coal River Collieries Company. J. T. Dunnigan, who was general manager of the old company, has been placed in the same position of the new company.

Scott Turner, director of the United States Bureau of Mines, has been designated by Secretary of Commerce Whiting to represent the Department of Commerce on the Advisory Committee of the Federal Oil Conservation Board.

A. F. Greaves-Walker has been named acting head of a department of mining engineering, which has been established at North Carolina State College of Agriculture and Engineering, Raleigh, N. C.

F. A. Linforth, assistant chief geologist of the Anaconda Copper Mining Company, was elected chairman of the Montana Section of the American Institute of Mining and Metallurgical Engineers at their January meeting at Butte. P. F. Beaudine was elected vice chairman, and Alex McDonald, secretary-treasurer.

President Francis A. Thomson of the Montana School of Mines has been chosen vice president of the Northwest Scientific Association, and Dr. Eugene S. Perry, head of the geological department of the school, has been elected secretary of the Geologic Section of the organization.

The International Smelting Company has announced the appointment of J. C. Brumblay as field representative in Nevada, with headquarters at Winnemucca. Mr. Brumblay was for many years in Nevada for the United States Smelting, Refining & Mining Co., and later for the Mason Valley Mines Co.

Charles A. Kittle, New York, president of the Ohio Copper Company of Utah, was in Salt Lake City, recently, for a visit to the mine and a consultation with local officials of the company.

Arthur E. Bendelari of Chicago, president of the Eagle-Picher Lead Company, has been elected a member of the board of directors of a Chicago banking organization formed through consolidation of the Central Trust Company of Illinois and Bank of America, both of Chicago.

Rocky Mountain Coal Institute To Convene at Salt Lake

Tentative plans for the winter meeting of the Rock Mountain Coal Institute on or about March 4-6 are being outlined by officials, according to Otto Herres, Assistant Manager of the United States Fuel Company. The three day session usually held in Denver will this year convene in Salt Lake.

Annual meetings are of two kinds: a winter meeting devoted to a discussion of coal production problems and a summer meeting, generally held in the field and devoted to inspection of mines in addition to symposiums on coal mining.

The Salt Lake meeting of the Rocky Mountain Coal Institute will be held in conjunction with sessions of the Utah section of the American Institute of Mining and Metallurgical Engineers.

Discussion will have as its central themes safety in coal mining operations and the application of mechanical methods to coal mining.

Two of the country's leading authorities on these topics will attend the institute to lead discussions. Acceptances, according to Mr. Herres, have already been received from Dan Harrington, Chief Safety Engineer of the United States Bureau of Mines and G. B. Southward, Mechanization Engineer of the American Mining Congress. All of the leading coal companies have assured members of the Rocky Mountain Coal Institute that representatives will be sent to the Salt Lake convention.

Explosion in No. 5 Mine of Kingston Pocahontas Company Takes 14 Lives

Fourteen miners killed in an explosion in No. 5 mine of the Kingston Pocahontas Coal Company at Kingston, W. Va., January 26th.

The force of the explosion was heard within a radius of a mile from Kingston. Rescue crews from nearby mines were mobilized and the State Mining Department and the U. S. Bureau of Mines rescue car at Welch notified.

Despite several fires that developed intermittently and other handicaps, rescue crews located and brought to the surface the body of the last victim less than 24 hours after the blast ripped through the workings of the mine. The rescue crews, working under the direction of R. M. Lambie, chief of the State Mining Department and aided by experts from the United States Bureau of Mines, fought their way forward from two entries, one on each side of the mountain and shortly before midnight accounted for the last man in the mine when the blast occurred.

Fifty-five men escaped safely, two of them after they became lost and had wandered about the passage ways for 12 hours after the blast. They were met by a rescue crew late in the afternoon and directed to the surface.

Sixty-nine men, composing the night crew, were underground at the time of the disaster. Fifty-five of them made their escape through the entry far back in the mountain, two of them after they had wandered about the workings almost 12 hours. About 500 men are employed at Kingston, the remainder being on the day shift.

Jeddo-Highland Coal Company Acquires Coxe Bros. Company

Announcement was made January 24, by Donald Markle, president of the Jeddo-Highland Coal Company, that negotiations have been successfully concluded whereby, effective April 1, the Jeddo-Highland Coal Company will take over for Coxe Brothers & Co., Inc., the management of all the Coxe coal properties except Stockton.

The Coxe breakers at Drifton and Beaver Meadow, Pa., will continue to prepare Coxe coal exclusively, and the output of these breakers will probably be sold by the General Coal Company of Philadelphia and the Fuel Service Company, of New York City.

CINCINNATI CONVENTION AND EXPOSITION

The Board of Governors of the Manufacturers' Division of the American Mining Congress has selected Cincinnati, Ohio, as the place and May 13-17 as the time for the Sixth Annual Convention of Practical Coal Operating Men and the National Exposition of Coal Mine Equipment, held annually under the auspices of the Mining Congress.

Mr. Paul Weir, vice president, Bell and Zoller Coal and Mining Company, Chicago, Ill., has accepted the chairmanship of the Program Committee and a committee representing every coal producing district is now in the process of organization. A meeting of this committee will be held in Pittsburgh, on Friday, February 8.

In the meantime a questionnaire has been sent to some 10,000 practical coal operating men, asking for their suggestion as to the topics they desire to have discussed at this meeting.

All exhibits will be staged this year on the ground floors and both north and south wings of Music Hall will be used. All sessions of the convention will be held in the theater which is directly between these halls.

The local Cincinnati people, including the Chamber of Commerce and the Cincinnati Coal Exchange, are cooperating actively in the development of the program and exposition. L. W. Shugg, through the courtesy of his company, The General Electric Company, of Schenectady, N. Y., will again serve as the Director of Exhibits. H. A. Buzby, of the Keystone Lubricating Co., Philadelphia, is chairman of the Manufacturers' Division, and is actively participating in the arrangements for space and the development of the program.

Mine Rescue Car Assigned to Northern West Virginia

A Bureau of Mines car will be sent permanently into northern West Virginia beginning January 1, according to announcement made by the Pittsburgh station, Bureau of Mines. The car is brought into the northern end of the state through the cooperation of R. M. Lambie, chief of the West Virginia Department of Mines, and J. J. Forbes, of the United States Bureau of Mines.

The car will be utilzed to train the miners of the region, the work to begin January 7 at Osage, Scott's Run. After remaining in the Morgantown section for about two months, the car will be taken to Fairmont about March 1. Later it will be moved to Clarksburg and Grafton.

The Mine Bureau is using the car in connection with what is termed its 100 percent training plan. Key men from the various mines, such as superintendents, foremen, and fire bosses, will spend three hours each night for five nights taking a rigid course under the direction of Bureau of Mines instructors. The key men in turn will instruct other employes of the mines until knowledge of safety methods and rescue work is placed within the reach of all. Evening will be devoted to training the key men, while the afternoons will be given over to special work with mine-rescue teams.

Propose Revision of West Virginia Mining Laws

Tightening of the mining laws of West Virginia to lessen the hazards for the underground workers will be sought at the present session of the legislature by the state department of mines, according to plans made at a conference of mine inspectors called by R. M. Lambie, head of the state department of mines, early in January.

Following the conference, Chief Lambie said his department would sponsor four bills that will be submitted to the lawmakers. They provide:

Appointment of two additional inspectors and three electrical inspectors.

Operation of electric lamps exclusively in all mines where gas has been detected by ignition, safety lamp or by air analysis.

Protective measures in development of natural gas and petroleum wells to protect life and property by prevention of intrusions of oil and gas into workable coal beds and to conserve the oil and gas resources in territory not underlain with workable coal beds.

Prohibiting use of fuse in mines in making compulsory use of electric detonators.

Attending the conference of inspectors with Chief Lambie were A. B. Spencer, of Elkins; Henry Jenkins and V. E. Sullivan, of Charleston; C. E. Foster, of Cabin Creek; Zach Evans, of Handley; J. A. Porter, of Gauley Bridge; W. H. Thomas, of Rainelle; Robert Lilly, of Mount Hope; W. L. McGinnis, of Beckley; Eli J. Mason, of Man; J. F. White, of Logan; and Robert R. Fields, of Madison.

Explaining the purposes of the proposed mine legislation, Chief Lambie said that during the last two years 159 men were killed by explosions of gas and dust, due to electrical ignition and ignition by open lamps.

"To minimize and, in fact, attempt to eliminate ignition of gas from these sources," Chief Lambie said, "the department of mines will sponsor two bills, one for the appointment of three electrical inspectors, whose duties would be to examine all electrical appliances, transmission and trolley lines, especially in mines liberating gas, and also to examine all substations located underground as well as electrical hoists and other mechanical equipment used for transportation or hoisting men or coal.

"The tremendous use of electrical appliances in coal mining demands such a service as this, as the state must assist rather than retard the use of electricity, and at the same time see that all safeguards are maintained for the protection of men and property.

"The department will ask the legislature to pass a bill, providing that all mines where gas has been detected by ignition, safety lamp or by air analysis, that they operate with approved electric lamps exclusively.

"The fact that there are only 25 inspectors for 25 districts makes it impossible for all districts to be worked continually and in compliance with the law, due to the inspectors being ill or off on vacation. It is also necessary, in many cases, for two or more inspectors to visit mines which are classified as extremely hazardous. That we can take care of this condition, without having to withdraw inspectors from their districts, we shall ask the legislature to provide two additional mine inspectors."

Brent Hart Reelected President of West Kentucky Coal Bureau

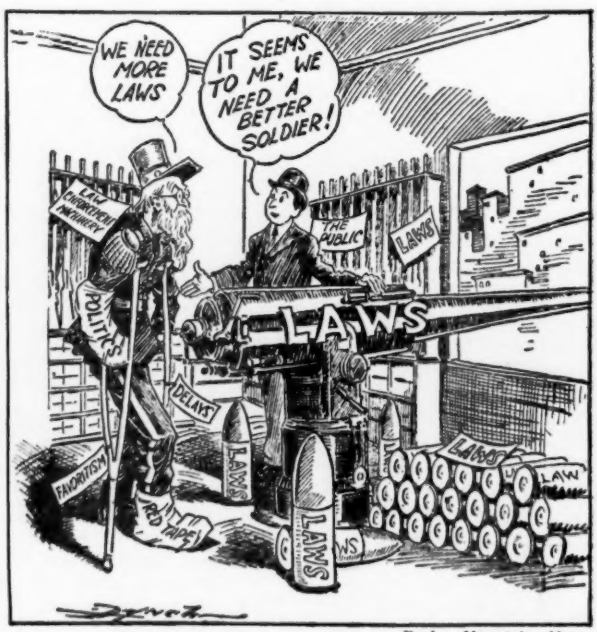
At the annual meeting of the West Kentucky Coal Bureau, held at Louisville January 8, all the officers were reelected for another year as follows: Brent Hart, president of the Hart Coal Corporation, Morton's Gap, Ky., president; A. P. Bernard, general manager of the Beaver Dam Coal Company, Louisville, Ky., vice president; and C. E. Reed, Starks Building, Louisville, Ky., secretary.

The executive committee for the coming year is: Percy D. Berry, president, Providence Coal Mining Company, Providence, Ky., chairman; A. W. Duncan, treasurer, W. G. Duncan Coal Company, Greenville; C. F. Richardson, president, West Kentucky Coal Company, Sturgis; M. B. Lanier, president, Norton Coal Mining Company, Nortonville; J. A. Smith, general manager, Gibraltar Coal Mining Company, Central City; C. M. Martin, general manager, Greenville Coal Company, Greenville; and K. U. Meguire, president, Dawson Daylight Coal Company, Louisville.

The meeting was followed in the evening by a banquet and entertainment in the Seelbach Hotel. The speakers on this occasion were Mr. Thurman Miller,

Philadelphia Public Ledger

Reporting early



Rocky Mountain News

The war on crime

of Wilmington, Ohio, and Executive Secretary Harry L. Gandy, of the National Coal Association.

Winding Gulf Operators' Association Elects Officers

The officials of the Winding Gulf Association for the coming year follow: W. A. Richards, of the Pemberton Coal & Coke Company, succeeds P. M. Snyder as president; P. C. Graney, of the C. C. B. Smokeless Coal Company, is vice president, succeeding W. G. Caperton; and A. W. Laing, of the MacAlpin Coal Company, is secretary-treasurer, succeeding C. H. Mead as secretary and himself as treasurer. L. L. Martin is retained as assistant secretary.

Lute Hornickel, Coal Operator, Dies

Lute Hornickel, who for many years has been president and general manager of the Anchor Coal Company, died at his home in Cleveland, Ohio, January 13, at the age of 72. He had been connected with the coal industry since his early years, having been associated with the Pittsburgh Coal Company, the River Coal Company, and the Hazel-Kirk Coal Company. At one time he was general manager of all properties of the M. A. Hanna Company. He purchased the Anchor Coal Company in 1912, and had, since that date, directed the policies of that company. He is survived by a widow, one son and one daughter.

Pittsburgh Coal Co. Had Largest Tonnage in Five Years

Pittsburgh Coal Company produced 10,577,040 net tons of coal in the Pittsburgh district last year making the largest tonnage since 1923. There was 30 percent gain over 1927 and production was more than double that of either of the two preceding years. Production was considerably heavier in the second half of last year than in the first half, both October and November showing over a million tons.

A $20,000,000 issue of Pittsburgh Coal Company 20-year 6 percent sinking fund debenture gold bonds, dated February 1, 1929, is being offered by the Union Trust Company and the Mellon National Bank, both of Pittsburgh, at 100 and accrued interest. Chairman W. G. Warden, of the coal company, has announced that the "proceeds from the sale of the bonds will be used for the redemption of the outstanding 5 percent debenture bonds aggregating $1,746,500 principal amount, for the payment of indebtedness incurred in modernizing the plants, for improvements and other corporate purposes."

Fairmont-Lowesville Coal Company Files Bankruptcy Petition

A voluntary petition in bankruptcy was filed in United States court at Fairmount, W. Va., recently, by the Fairmount-Lowesville Coal Company, and after a brief hearing before Judge William E. Baker, an order of adjudication was entered.

The petition, presented by Attorney W. H. Conway, of Fairmont, upon application of John Y. Hite, president of the concern, represented one of the largest actions ever filed in the bankruptcy court. No date was set for a formal hearing.

Schedules filed with the petition listed assets at $456,840 and liabilities at $480,930. Included in the liabilities were preferred claims of $284,240, unsecured claims of $124,173, notes and bills of $8,000, and taxes of $13,591. Machinery valued at $169,379, real estate at $244,000 and open accounts of $39,525 were listed as assets.

Carnegie Coal Company Faces Foreclosure

The Colonial Trust Company of Pittsburgh has instituted foreclosure proceedings in United States district court at Pittsburgh, Pa., against the Carnegie Coal Company on a first mortgage of $7,500,000 and a second mortgage of $1,000,000.

C. C. McGregor, one of the receivers of the coal concern, said the court action would not disturb the present business of the company. He added the step was taken as an aid in the reorganization which has been in progress three years.

McGregor and W. M. Wilshire, who have been receivers for the coal company during that period, have been named permanent receivers in the foreclosure.

Mine Extension Class to Start in New River

Advanced classes in mine foremanship and superintendence in the New River, West Virginia, field will be started at once at the high schools of Mount Hope and Beckley, under direction of Andrew Smith, of Scranton, Pa., who has been assigned to that district by the dean of the school of engineering of West Virginia University, it was announced recently by R. H. Morris, general manager of the Gauley Mountain Coal Company, of Ansted, W. Va., who is chairman of the educational committee of the New River Coal Operators' Association.

Classes in coal education resulted in a cooperative plan agreed upon by the state board of education in cooperation with the committee of the New River operators, which is composed of Mr. Morris, Gilbert Smith, of Fayetteville, and J. P. White, of Raleigh. It is the first step of the university in advanced training of mine employes in drainage, timbering, ventilation, and actual operating problems. Mr. Smith was formerly connected with the Hudson Coal Company.

Union Approves Machinery Use

Ellis Searles, editor of the *United Mine Workers Journal*, recently made public a statement setting forth the attitude of the United Mine Workers of America on the introduction of machinery and other modern mining methods into the mines of the country. The statement declared that the union does not oppose the introduction of mechanical devices in coal mining and that "when mechanization of mines comes as a matter of progress we are for it."

The statement, in part, said:

"The United Mine Workers of America favors anything and everything that is of benefit to the coal mining industry, whether this benefit comes through the introduction of mechanical methods or otherwise. Any new thing that is worth anything to the industry will be a benefit to the mine worker. If it does not help to improve the condition of the mine worker, it is worthless to the industry and should not be adopted.

"We are not opposed to the introduction of machinery in the mines, but we do contend that when a machine is installed that effects a saving in costs a fair and just portion of that saving should go to the mine workers themselves. There is no good reason why all of these savings should go into the pocket of the operator."

Bethlehem Mines Corp. Will Hold Safety Meeting

A first aid meeting involving the 1,500 miners of the Bethlehem Mines Corporation in Northern West Virginia, will be held in Fairmont on February 27, according to an announcement made by Robert Reid, of Barrackville, local safety engineer of the company.

J. V. Berry, of Johnstown, Pa., chief safety engineer of the company, will have charge of the program.

Mine Code Presented Before Oklahoma Legislature

A bill covering lead and zinc mining regulations in Oklahoma has been introduced in the state senate by A. L. Commons of Miami, representing Ottawa, Cherokee and Delaware counties. The mining code introduced by Senator Commons was drafted by Charles Neal and John Newton, of Miami, members of the mining code commission appointed a year ago by Governor Johnson.

"Rock-Dusting by Hand Methods"

The U. S. Bureau of Mines has just issued Circular No. 6087, on "Rock-Dusting by Hand Method." The authors, Messrs. Harrington and Owings, of the Safety Division, claim that many mines supposedly well protected by rock-dusting were in reality not even 1 percent protected.

The Bureau claims that "there should be no part of any bituminous or lignitic coal mine in which all the exposed surfaces (roof, ribs, and floor) have not been thoroughly rock-dusted and kept thoroughly rock-dusted * * * so that the combined rock-dust-coal-dust mixture at all times and in all places has less than 35-40 percent combustible matter."

The article discusses difficulties in mechanical dusting, rock-dusting of abandoned workings, dusting of wet entries, and the necessity for the miner himself to be alert to its value.

The authors recommended compulsory rock-dusting to the Nth degree, even to the requirement of hand-dusting methods up to the face of every working place in every coal mine, large or small, in the United States, to the extent of 5-10 pounds of rock dust per linear foot of advancing opening. They propose that rock dust should be supplied the miner by the company as rails, ties, and timber now are, thus distributing the responsibility between worker and company.

Process for Treating Refractory Ores Containing Precious Metals

A furnace and process for treating refractory ores containing precious metals has been patented by George W. B. Evans, of Wilderness, Va. (Patent No. 1,636,467), by which it is claimed that all ores of this character can be successfully and economically treated. The ore is first pulverized, then placed in the furnace and subjected to a chemical treatment, under great heat, by which the metallic compound crumbles and the different metals separated and released, the various volatile elements being driven off into condensers and saved, leaving the metals to be recovered, free in the ore, which can then be easily recovered by cyanide, chlorine or amalgamation.

The inventor states that: "It must be understood that the process does not recover the gold direct from the ore, but puts the ore in such a condition that it may be easily and more completely extracted."

The Evans Ore Reduction Company has been organized for the purpose of acquiring the rights and letting the process on a royalty basis.

Increased Use of Electricity in British Coal Mines

British coal mines are using a steadily increasing quantity of electrical coal-cutting machines, as well as increased electrical equipment in general, according to the Department of Commerce.

Report of the British electrical inspector of mines for the calendar year 1927, which has recently been issued, shows that only 1,797 electrically operated coal-cutting machines were in use in 1918, but that 3,478 were employed in 1927, Trade Commissioner Homer S. Fox, London, says in his report.

The machines are not evenly distributed in the various British coal districts, Scotland and the northern districts together having practically half of the total number of machines in use throughout the country. In Scotland 56 percent of the total output of coal in 1927 was cut by machines, as compared with 23.3 percent for the entire country. Northumberland is next with 42 percent of its total output mined by machine, while in the districts of Somerset, Bristol and the Forest of Dean only 3 percent of the total output was machine cut.

The use of electricity in coal-mining operations continued to increase in 1927; about 64,000 horsepower was added. The average annual addition during the past five years has been about 88,790 horsepower.

CONGRESSIONAL COMMITTEE HOLDS HEARINGS ON REVISION OF TARIFF LAW

The House of Representatives Committee on Ways and Means began early in January to hear arguments of producers and consumers of numerous commodities for and against the continuance or raising of tariff duties. The metal schedules received considerable attention and it is likely that the next tariff law will carry many changes.

During executive session consideration of the new tariff law, the House Committee on Ways and Means will pass on recommendations of The American Mining Congress for continuation or upward readjustment of present duties on 26 mineral products. Request for tariff protection for the following mineral producing industries has been made by The American Mining Congress:

Continuation of present duties on bismuth; cadmium; fluorspar and magnesite, including the increased duties granted by the President; graphite; lime; monazite and thorium; quicksilver; talc.

Continuation of present duty on lead, unless conditions develop later to make a higher rate imperative.

Continuation of present duty on zinc, with the possibility of a higher tariff because of developments in Canada and Mexico.

Continuation of present duty on molybdenum, although an increase may be desired as foreign low-cost production is a menace to the American industry.

Antimony, increase from 2 to 4 cents per pound.

Metallic arsenic, 6 cents per pound; arsenious acid or white arsenic, 4 cents per pound.

Barytes, $8 per short ton.

Bauxite, $3 per long ton.

Crude feldspar, $2 per ton; ground or manufactured, $6 per ton.

Crude gypsum, $3 per ton; crushed gypsum, $3.50 per ton; calcined gypsum, $4.25 per ton.

Kaolin, $3.75 per ton.

Crude mica, 25 percent ad valorem and 25 cents per pound for mica valued at 26 cents per pound, with increases up to 100 percent ad valorem and $1 per pound on mica cut to size.

Potash, 50 cents per unit.

Unmanufactured pumice stone, 1/10 cent per pound; manufactured, 1 cent per pound; manufactures of pumice stone, 35 percent ad valorem.

Travertine, 50 percent ad valorem, and to forbid its free entry as ship ballast.

Metallic tungsten, 67½ cents per pound.

Marble and asbestos duties as recommended by producers.

In support of the duties M. W. Kriegh, Chief of the Tariff Division of the American Mining Congress, furnished the committee with information pertaining to these industries, giving sources of imports, labor costs at home and abroad, relative trade balance between the United States and foreign countries, exchange rates, nature and extent of domestic and foreign ore deposits, foreign and domestic costs of production, prices, domestic production, states in which produced, employes and dependents upon each industry in the United States, approximate investment in each industry in this country, present conditions in these industries in the United States, and estimated percentage of foreign and domestic products that will be consumed under a correct tariff.

"The position of The American Mining Congress with respect to these industries which it represents is that when any American mining industry buys its plant, equipment, supplies and labor in a protected market, it should be permitted to sell its minerals, which are its product, in a protected market," says Mr. Kriegh. "The American Mining Congress on behalf of these industries asks that they be granted such protection as will enable them to operate and employ American workmen at an American scale of wages based on an American standard of living. The policy of American industry for Americans and Americans for American industry should continue to be the policy of this Government. In every case where our mining industries merit it, adequate protection should be granted."

Mr. Kriegh referred to the survey made by The American Mining Congress through Dr. Henry Mace Payne, its consulting engineer and geologist, as to the undeveloped mineral resources of the

South. "With no other purpose in view than the disclosure of mining possibilities of the South, this organization had this eminent mining engineer and geologist conduct this survey," says Mr. Kriegh. "Practically all of these minerals on which we request a tariff exist in the Southern States in quantities greater perhaps than was realized by anyone before this survey was made." The services of Dr. Payne have been made available to the committee in checking data on southern minerals.

A duty of 4 cents per pound on imported crude or refined arsenious acid or white arsenic was favored before the committee by H. C. Bacorn, general manager of the Jardine Mining Company, of Gardner, Mont. The duty would also apply to the arsenious acid content of arsenic bearing ores, now admitted free of duty. Half of the arsenic used in this country is now imported, mainly from Mexico, Canada and Japan. The price of the foreign product in New York is between 3½ and 4 cents, while the cost of production in this country is between 7 and 8 cents per pound. Mr. Bacorn stated that companies mining and producing arsenic from ores have been put out of business by the low-cost imported product.

An increase in the duty on fluorspar from $8.40 per gross ton, or $7.50 per net ton, to $11.20 per gross ton, or $10 per net ton, was requested by G. H. Jones, of Chicago, representing the Hillside Fluorspar mines, and a committee composed of R. C. Allen and B. E. Clement, as representatives of fluorspar producers of Illinois and Kentucky. Mr. Jones stated that the recent report of the tariff commission under which the President increased the duty by 50 percent under the flexible provision fully justifies the new duty. He stated that fluorspar mining was conducted in 1927 by 8 companies in Illinois, 14 in Kentucky, 2 in Colorado, and 2 in New Mexico. Mr. Jones said that American producers are primarily interested in the metallurgical grade and that reserves of fluorspar are adequate for all purposes. He stated that if the duty is increased, the market for fluorspar will be widened without an increase in price.

Increase of the duty on imported crude barytes ore to $4 per ton was requested by H. N. Hanna, of Baltimore, vice president of the Clinchfield Sand and Feldspar Corporation. The company mines ore at King Creek, Cherokee County, S. C. Freight rates from American mines to the seaboard are 80 to 100 percent higher than the ocean rates from Germany to the same point, it was said.

Mica producers and miners of North Carolina recommended a reclassification and increase in duties on mica as follows: Crude, knife or thumb trimmed, 25 percent ad valorem and 12½ cents per pound on mica valued at 26 cents per pound, 20 cents per pound on mica valued at 52 cents per pound, and 25 cents per pound on mica valued at over 52 cents per pound; mica cut to size 60 percent ad valorem and 50 cents per pound; muscovite mica not cut to size 40 percent ad valorem, cut to size 100 percent ad valorem, or $1 per pound; phlogopite mica splittings not cut to size 40 percent ad valorem; mica waste or refuse fit only for grinding purposes, 1 cent per pound; ground or pulverized mica 2 cents per pound. The duties were asked by the Tar Heel Mica Co., of Plumtree; Asheville Mica Co., of Biltmore; New Hampshire Mica and Mining Co.; Tennessee Mineral Products Co., of Spruce Fine, N. C.; Spruce Pine Mica Company and mica miners of Spruce Pine.

An increase of the duty on vanadium chemicals from 25 to 50 percent ad valorem was requested by the Union Carbon and Carbide Corporation and the Vanadium Corporation of America.

A. Cressy Morrison, of the Carbide and Carbon Chemical Corporation of New York, told the committee of the work of his organization in building up a chemical industry by utilizing waste raw materials, including gases escaping from oil wells. The company has spent $15,000,000 in research and plant construction. He asked for continuance of the present duties on chemicals and duties on newly developed chemicals, both totaling 160 products. Because of the absence of a tariff in former years on calcium carbide the company had built plants in Canada and Norway. The company is now constructing a chemical plant in West Virginia.

Nelson Franklin, of Washington, D. C., representing the Sierra Magnesite Company, of Porterville, Calif., requested continuance of the present duty on caustic calcined and crude magnesite, including the 50 percent increase recently granted by the President on report of the Tariff Commission. He said there is a market for grained magnesite in the copper industry.

On behalf of a number of companies, Mr. Franklin requested a 50 percent increase in the tariff on tungsten ore and concentrates and corresponding increases in compensatory duties on manufactured finished products of tungsten. These duties were requested on behalf of the Nevada Massachusetts Company of Mill City, Nev.; Alex Ransom, of Reno; Tungsten Products Company and Round Valley Tungsten mines of Bishop, Calif.; Tungsten Reef Mines Company, of Hereford, Ariz.; Tungsten Production Company and Wolf Tongue Mining Company, of Boulder, Colo.; and the Rare Metals Ore Company, of Rollinsville, Colo. Under the present duty only the lowest production cost mines have operated, and nearly all of these have suffered losses and have received nothing as a return on invested capital or for depletion of reserves. Although they have large reserves of ore, one company ceased operations in 1927 and another in 1928. The increased tariff will permit sufficient mines to operate to produce 2,500 tons annually.

Manganese Duties

The New Jersey Zinc Company and the American Manganese Producers Association requested that the duty on spiegeleisen be $2 per ton higher than the duty on pig iron.

The manganese association, through its president, J. Carson Adkerson, requested that the duty on ore having a manganese content of 25 percent or more be increased from 1 cent to 1½ cents per pound, the same as the duties on lead and zinc. It also requested a duty of one-half of a cent per pound on ore of a manganese content of from 10 to 20 percent. The association estimated that the United States has 150,000,000 tons of ore containing from 10 to 15 percent of manganese content and that 1,500,000 tons of high grade ore have been blocked out.

C. A. Buck, of the Bethlehem Steel Company, who spoke for the greater part of the steel industry, asked that manganese ore be admitted free and that the duty on ferromanganese be reduced. He stated that the present duty on manganese is equal to 100 percent advalorem and more than three times the average duties on finished steel products. Declaration was made that the manganese duty has cost the steel industry $50,000,000 on imports since it was imposed in 1922. "No other raw material is taxed as heavily as manganese," said Mr. Buck, who added that the industry has had to rely on foreign manganese for 93 percent of its requirements. He declared that the duty had not developed the manganese industry in this country, but had increased the cost of manufacturing steel and added to the difficulty of the industry in competing with foreign steel.

Manganese duties were urged by H. A. Pumpelly of the Domestic Manganese and Development Company of Butte, which he said has spent $400,000 on a plant for treating manganese carbonate ores. In three months the plant has produced 12,000 tons of sintered ore containing 56 percent metallic manganese content. The mine is owned by the Butte Copper and Zinc Company and operated jointly by the Anaconda Copper Mining Company.

H. P. Henderson, mining engineer of New York, recommended an increase in the duty on antimony metal, antimony in alloys, and antimony oxide from 2 to 4 cents per pound and retention of antimony ore on the free list. If the duty is increased, Mr. Henderson said, an antimony smelter will be established in Texas to treat ore from Mexico.

The F. K. Higbie Supply Company, of Chicago, and L. A. Salomon and Brothers, of New York, asked for a reduction in the duty on fuller's earth to $2 per ton.

The Kalbfleisch Corporation, of New York, asked that bauxite ore be admitted free because American resources are being depleted. The company stated that more of this product is being imported than is being mined. The duty of $1 per ton on the imported product from the Dutch and British Indies was said to be adding to the cost of this essential raw material, which is used by the chemical abrasive, metal and other manufacturing industries.

Steel Duties

Specific rather than ad valorem duties on various iron and steel products will be later requested by the American Iron and Steel Institute. John A. Topping, of New York, vice president of the institute and a representative of the chairman of the board of directors of the Republic Iron and Steel Company, advised the committee that the steel interests will request sufficient duties on competing foreign products in order to maintain the American industry on a reasonable basis of profit and to continue present wages. He stated that foreign steel bars can be laid down at Atlantic ports at $9 per ton less than the American product. While the industry has invested capital of $4,700,000,000 and employs 1,500,000 people, the return on the investment is less than 5 percent. In the case of ad valorem duties they will be based on wholesale prices at ports of entry.

WITH THE MANUFACTURERS

American Rheolaveur and Koppers Companies Consolidate

An interesting item of news to the coal and ore mining industries is the announcement of the formation of a new company which will be known as the Koppers-Rheolaveur Company.

This company has been made up through the affiliation of the Koppers Company, of Pittsburgh, with the American Rheolaveur Corporation, of Wilkes-Barre and New York City. The purpose of which is to broaden the scope of service in the matter of the cleaning and preparation of coal and the concentration of ores.

The American Rheolaveur Corporation was formed in 1925 to develop the use of the "Rheolaveur Process" in the United States, Canada and Mexico. It was an engineering and sales corporation organized to study coal and ores in a laboratory maintained for this purpose and to cooperate in the design of plants and mills using the "Rheolaveur Process." Through its affiliation with the Koppers Company the new organization will add to the former activities those of contracting and constructing.

The "Rheolaveur Process" is a process patented by Antoine France, of Liege, Belgium, for the cleaning of coal and the concentration of ores. It has been used in Europe and other parts of the world for several years.

The Koppers Company and its subsidiary, Koppers Construction Company, are the most prominent engineers and constructors of by-product coke ovens in this country.

It might be interesting to note that although the American Rheolaveur Corporation was in existence only slightly over three years, there was during that time installed Rheolaveur coal washing equipment having a capacity in excess of 12,000,000 tons per year. During the past year this company has been supervising the engineering and installation of three of the largest and most complete bituminous coal washing plants which have ever been installed in the United States. The first and second of these plants, namely, the Champion and Warden plants of the Pittsburgh Coal Company, have been placed into operation. The third, or Banning plant of the same company, will be completed early this year.

The Champion plant, being a central washing plant for five mines, is designed to wash by the "Rheolaveur Process" in excess of 10,000 tons of coal per day. The Warden and Banning plants each have a washing capacity by the same process of 5,000 tons per day.

In each of the above plants Carpenter driers are used for mechanically drying wet washed fine coal and for this purpose have proven eminently satisfactory. The design, manufacture and sale of the Carpenter drier were taken over by the American Rheolaveur Corporation about two years ago as a desirable supplement to efficient wet washing plants.

In the anthracite region the American Rheolaveur Corporation has installed the "Rheolaveur Process" in several breakers, the largest being that of the Loomis Colliery, of the Glen Alden Coal Co., the capacity of this plant being 6,000 tons of shipped coal per day.

Immediately after the formation of the original company a laboratory was installed for the studying of coal and ores by float and sink methods and the practice developed in this laboratory has largely become the standard method of studying coal and ores before considering cleaning and concentrating methods. In this laboratory considerably more than 100 complete reports on the washability of coals have been made for the various companies making use of the advantage offered.

The first plant for the concentration of ores has been installed and has been operating for several months. Preliminary results on this plant indicate a marked improvement in recoveries and concentrates as well as a simpler and more easily maintained flow of materials through the mill. No definite announcements have been made as to the results obtained with this concentrating plant, but these will undoubtedly come forth at the proper time.

At a meeting of the board of directors of the General Electric Company on January 4 in New York, William J. Hanley, manager of the East Central District, with headquarters in Cleveland; and Charles K. West, manager of the Atlantic District, with headquarters in Philadelphia, were elected vice presidents in charge of the commercial activities of the company in their respective districts.

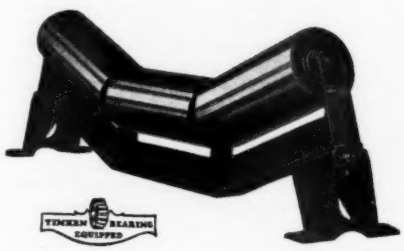
Allis-Chalmers Announces Enlarged Texrope Stock

On account of the increasing demand for immediate shipment of transmission machinery, it has been necessary for the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., to enlarge their stock of "Texrope" drives up to 50 hp. In 1927 an announcement was made that Texrope drives from 2 hp. up to 15 hp. were being carried in stock ready for immediate shipment. This was received so favorably that at the present time this stock of Texrope drives has been increased to include all the popular motor speeds and ratings up to 50 hp., with a large choice of driven speeds in a range of ratios from 1:1 up to 7:1.

A catalog has been prepared to make selection of a suitable Texrope drive a simple matter, and will be sent upon request to the company.

New Heavy-Duty Belt Conveyor Idler for the Mining Industry

A new heavy-duty belt conveyor idler, designed especially for the mining industry, has just been added to the standard Link-Belt line of antifriction belt conveyor idlers.



The rollers are 8 in. diameter, of ⅜ in. boiler tubing, and are mounted on 1¼ in. diameter shafts with heavy Timken tapered roller bearings. Roll ends are of Link-Belt malleable iron. Each roll shaft is fitted with Alemite industrial fittings.

The same ideas of grease seal and general design found in the standard types of Link-Belt antifriction belt conveyor idlers have been carried out in the new type. Absolute protection of the bearing is afforded by a labyrinth grease seal, mounted in a grease cap which also serves as an outboard reservoir and lubricates the bearing on the outside as well as on the inside.

This new heavy-duty idler is built for belt widths from 30 to 60 in.

New Turret-Type Mine Harp and Pole Head Casting

A new turret type mine harp and pole head casting for wheel and glider operation has recently been announced by the Ohio Brass Company, Mansfield, Ohio.

This device is known as the turret type because of the turret-shaped bearing between the pole head casting and the swivel harp casting. A projecting turret on the pole head casting 1½ in. in diameter and 1⅜ in. high, fits into a corresponding socket on the harp casting, making a smooth machined bearing of large area. Both harp and pole head casting are made of Flecto malleable iron.

Trolley Harp for Wheel Operation

While the harp for glider operation also utilizes the turret principle, it is somewhat different in design from the harp for wheel. Connection between the glider and harp is made by large ball and socket joints. Heavy copper bearing-washers formed to the contour of the ball are fitted between the ball and socket joints. The wear at these joints falls on the washers, thus materially increasing the life of the harp.

The glider itself is pivoted at the center of contact, overcoming all tendency to rotate either forward or backward. Where very heavy service is encountered and extremely high currents are used, a copper shunt attached to the glider is used to carry the current around the harp to the terminal on the pole head casting shunting the current around the working parts.

A. E. Blackwood Elected President of Sullivan Machinery Company

At a special meeting of the board of directors of the Sullivan Machinery Company held December 31 at its Boston office, Mr. Arthur E. Blackwood, of Chicago, was unanimously elected president of the company, succeeding the late Mr. Frederick K. Copeland.

Mr. Blackwood has been with the Sullivan Machinery Company for the past 32 years. He came to the company shortly after graduating at Toronto University as a mechanical and electrical engineer, and later became manager of its eastern sales department, with headquarters in New York, which office he held for 23 years. He was then elected a director and first vice president in charge of finances, and moved to the company's head office at Chicago, where he continued in close relation with Mr. Copeland until the latter's death in November of last year.

Orders received by the General Electric Company during the year 1928 amounted to $348,848,512, compared with $309,784,623 for 1927, an increase of 13 percent, President Gerard Swope announced.

General Electric Research Developments During 1928

A vacuum tube operating on a wave length of six meters, and 50 times as powerful as preceding short wave tubes; the use of the thyratron tube for furnace temperature control; added experiments with the cathode ray tube; development of a direct-current vacuum fuse; a new recording spectrophotometer or color analyzer; and the development of tungsten carbide cutting tools, are among the research developments during the past year enumerated by John Liston of the General Electric Company in his annual review of electrical progress.

DEMONSTRATES EFFECTIVENESS OF EXPLOSIVES SERVICE FOR COAL MINES*

Technical Representative Of Powder Manufacturer Developed And Introduced New Method—Shooting Better And Nearly 25 Percent Less Costly

DU PONT pellet powder is being used successfully at the Brookside mine, of the Harlan Collieries Company, of Ages, Ky., at the rate of about three carloads annually as a result of intensive educational work by a du Pont technical representative, A. L. Millegan.

Early Experiments

The Brookside mine is located in the southeastern Kentucky field where the bituminous seam averages 48 inches in thickness. The mine is now working 35 entries from a single shaft and is regarded as one of the most modern in this section of the country.

Mr. Millegan did most of his work right in the mine, experimenting with several methods of drilling and varying the amounts of pellet powder used until exactly the right combination had been developed to get down the highest possible percentage of lump coal from this particular seam at the lowest drilling and explosives cost.

These trials proved that a slight change was needed in the method of cleaning out the under-cut and that two charges properly placed would give results equal to those formerly had with three shots of black powder.

The next move was the training of the miners. This, involving both a new method and a new type of explosive, required considerable tact as well as technical skill. The men had always done their own shooting at this mine and it was natural that many should have believed themselves able to get 100 percent results with their long-established methods.

Experience had shown the proper method of approach for such a problem, and Mr. Millegan, by working side by side with the men, quickly aroused a desire on their part to be shown just what could be done. The problem was virtually solved as soon as this idea had gotten across, and a little individual work with each man soon made the entire crew proficient in the use of pellet powder.

Results Obtained

The management is well pleased with the results. No accurate check has been made to determine the increase in percentage of lump coal brought down but it is known that the standardization of shooting methods, and particularly of the quantity of explosive used, is permitting the production of better coal.

An increase in output per man is also to be looked for due to the reduction of 33 percent in drilling and because pellet powder is easy to handle and causes little smoke which might delay the work. This effect is not yet evidenced in the records but it remains as a source of possible additional gain.

The miners are now getting 7.64 tons of coal per pound of pellet powder, whereas they formerly got 5.76 tons with black powder.

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* Survey made by A. C. Nielson Company, engineers, in collaboration with and approved by B. W. Whitfield, Jr., general manager, Harlan Collieries Company, Ages, Ky.

Magnetic Mfg. Co. Changes Product Trade Name

The Magnetic Manufacturing Company, Milwaukee, Wis., manufacturers of the high-duty magnetic separators, magnetic clutches and special magnetic equipment, announces that in the future its products will bear the trade name "Stearns," in addition to the former trade name "High Duty." This action was prompted by the need for a more specific identification of its products as compared to the general term "High Duty" used in the past. The new designation is derived from the names of company officers, R. H. Stearns, president and treasurer, and R. N. Stearns, secretary.

UNDERGROUND HAULAGE AT THE UNITED VERDE MINE

By E. W. Fredell*

AFTER the mining of the ore comes the problem of getting it to the surface with a minimum of expense. One of the large items of cost in this operation is haulage.

At the United Verde the haulage system has been worked out according to the following plan and equipment chosen best suited for each condition.

Main Ore Haulage

All of the ore production, whether hoisted from the levels below or passed through raises from the levels above, is assembled in eight storage bins located on the 1,000-ft. level. From these bins an adit, 8,500 ft. in length, leads to the surface ore bins, making a total haul of 9,500 ft. on this line.

Track is standard gauge, with 75-lb. rail and a grade of one-half of 1 percent in favor of the loaded trains. A train consists of nine 20-ton cars of 40 tons capacity each, making a total trailing load of 540 tons.

Due to the long haul and the heavy loads handled, 25-ton trolley locomotives were chosen. Four locomotives are in use on this level, and when pushed to the limit, work in 8-hour relays. The relay operation of locomotives provides spare locomotives in cases of emergencies and a service condition culminating in economical maintenance. These locomotives have pneumatic control, and are equipped with 50 cu. ft. capacity compressors to enable them to handle train line air as well as the straight air on the locomotive.

Man and Material Haulage

The Arizona state law provides that all underground men shall work eight hours from collar to collar, that is, the men go down and come up from the mine on company time.

As the adit on the 500-level is 2,100 ft. long and all the men can not be handled on one cage load, the company hauls the men to the shaft in so-called "Pullman" trains. Two trains are used, making three trips each at shift time. Ten-ton standard gauge trolley locomotives, equipped with manual control and straight air on locomotives, are used on this run. Track is 75-lb. rail, and the grade is one-half of 1 percent against ingoing loads.

The shops are located on this level also, so all timber, steel, and miscellaneous supplies are handled through the same adit. As the mine track gauge on the various levels is 18 in., and 18-in. gauge track was consolidated with the standard gauge. The inconvenience of trolley wire above the yard tracks, as well as around the shops, was the determining factor in choosing a storage battery locomotive for the supply service. A 5-ton storage battery locomotive, equipped with two batteries, is in use at the present time. The use of the second battery enables the locomotive to be used in continuous service.

Ore Handling on Various Levels

The track gauge on all levels in the mine is 18 in., and the hauls vary from 600 to 1,300 ft. The cars in use at present in the newer part of the mine are 30 cu. ft. rocker bottom with roller bearing wheels. Sixteen loaded cars constitute a train. In the older portions of the mine, side dump cars of 18 cu. ft., with roller bearing wheels, are used. Eighteen to 20 of these cars are the customary number in a train.

On all levels except those opened up within the past six years trolley haulage is used. The locomotives are of two sizes, namely, the four and the six ton sizes. Eighteen trolley locomotives are in use at present. On all the newer levels, battery locomotives are used. These also are of two sizes, three and one-half and five-ton locomotives. At present battery locomotives are handling the majority of the levels that are on heavy production of ore, as well as those that are in the development stage. Fourteen of these locomotives are in use at present, and more will be used in the future. Two batteries are used with each locomotive, and charging stations are on each level, allowing for 24-hour service. The maximum tonnage available, with two locomotives working two shifts, is about 1,000 tons over a 1,000-ft. haul.

The present policy of this company is to expand their storage battery operations and curtail the trolley locomotive operations. The principal advantages found at this property for storage battery locomotive operation are as follows:

(1) Elimination of fire hazard from trolleys.

(2) Elimination of trolley hazards for men loading ore at chutes and in the drifts.

(3) Lower maintenance costs.

(4) Convenience in having haulage at any point to which tracks are laid.

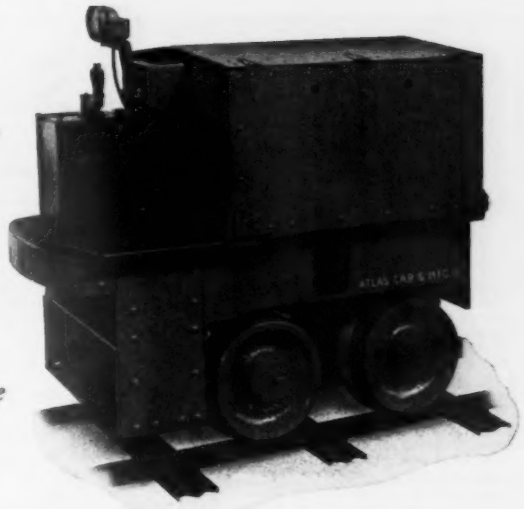
Track conditions are maintained to a degree considerable above the average for a mine. Forty-pound rail is used, and curves are kept to a minimum of a 30-ft. radius. Maintaining good track is the secret of getting out a heavy tonnage with a minimum of abuse to the equipment.

* Chief Electrician, United Verde Copper Co.

25-ton Baldwin-Westinghouse Trolley Type Locomotive

5-ton Baldwin-Westinghouse Battery Type Locomotive

On the level



The Atlas Type "J"
Tramming Locomotive

or on the cage

This locomotive is of such simple construction that it gives maximum service for the power consumed, any maintenance required is easily taken care of by inexperienced mechanics.

Its weight is approximately that of a loaded mine car so that it does not overload either hoisting equipment or track. Built for different track gauges and is narrow enough to pass timbering in drifts.

to another level

Specifications

Track Gauges	18 to 24 inches
Weight Chassis only	2000 pounds
Weight with 40 cells A5 Edison	2700 pounds
Weight with 20 cells MVA15 Exide-Ironclad	3140 pounds
Weight with 20 cells PML17 Philadelphia	3080 pounds
Rated Drawbar Pull 400 *pounds at* 3.5 *miles per hour.*	
Maximum Drawbar Pull—Cast Iron Wheels	750 pounds
Maximum Drawbar Pull—Steel Wheels	900 pounds
Speed 2.5 to 6.5 miles per hour.	
Length overall on cage	47 inches
Length overall with seat down	54 inches
Height to top of battery box	45 inches
Height overall of headlight	50 inches
Width	32½ inches
Wheel base	20 inches
Diameter of wheels	14 inches
Minimum Radius of Curve	8 feet
Minimum Weight of Rail	8 pounds

Ask for a folder describing in detail construction, adaptability, and performance.

THE ATLAS CAR & MANUFACTURING CO.

Engineers CLEVELAND, OHIO **Manufacturers**

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ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

ACID, SULPHURIC
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Ingersoll-Rand Co., 11 Broadway, New York City.
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Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

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General Electric Co., Schenectady, N. Y.

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Robinson Ventilating Co., Zelienople, Pa.

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CAR DUMPERS, GRAVITY & POWER
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR DUMPERS (Rotary)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR FEEDERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CAR HAULS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CARNOTITE ORES
O. Barlow Willmarth, Georgetown, Colo.

CAR PULLERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CAR REPLACERS
Johnson Wrecking Frog Co., Cleveland, Ohio.

CAR RERAILERS
Johnson Wrecking Frog Co., Cleveland, Ohio.

CAR RETARDERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

CARS, Coal
C. S. Card Iron Works Co., 16th & Alcott Sts., Denver, Colo.

CARS, Metal Mine
C. S. Card Iron Works Co., 16th & Alcott Sts., Denver, Colo.

CARS OF ALL DESCRIPTION
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

CAR STOPS, AUTOMATIC & MANUAL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

CAR WIRE & CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CASTINGS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Timken Roller Bearing Co., Canton, Ohio.

CASTINGS, GRAY IRON
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS, OPEN HEARTH STEEL
Vulcan Iron Works, Wilkes-Barre, Pa.

CASTINGS (steel, iron)
Vulcan Iron Works, Wilkes-Barre, Pa.

CAST STEEL FROGS
Central Frog & Switch Co., Cincinnati, Ohio.

CHAINS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CHAINS, DRIVE
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAIN LUBRICANTS
Standard Oil Co. (Ind.), Chicago, Ill.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, Silent (Bushed-Pin Joint)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CIRCUIT-BREAKERS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, GUARD RAIL
Central Frog & Switch Co., Cincinnati, Ohio.

CLAMPS (Mine)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CLAMPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CLIPS, WIRE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CLOTH, WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CLEANING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
American Rheolaveur Corporation, Wilkes-Barre, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL COMPANIES
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.

COAL CONVEYING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CRUSHERS & ROLLS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COAL LOADERS
Conveyor Sales Co., 299 Broadway New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

COAL MINING PLANTS
American Coal Cleaning Corpn., Welch, W. Va.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL PREPARATION MACHINERY
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

COAL SEPARATING MACHINERY
W. S. Tyler Co., Cleveland, Ohio.

COAL SEPARATORS (Pneumatic)
American Coal Cleaning Corpn., Welch, W. Va.
Roberts & Schaefer Co., Chicago, Ill.

COAL SEPARATORS (Spiralizers)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL TESTING EQUIPMENT
W. S. Tyler Co., Cleveland, Ohio.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago, Ill., and New York.

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONTROLLERS
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVERTERS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CONVEYORS
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

CONVEYOR BEARINGS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, COAL
American Coal Cleaning Corpn., Welch, W. Va.
Conveyor Sales Co., 299 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, PAN OR APRON
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
American Coal Cleaning Corpn., Welch, W. Va.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COOLERS, Man
Robinson Ventilating Co., Zelienople, Pa.

COOLERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

COPPER WIRE & STRAND (Bare)
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

CORE DRILLS, Carbon (Diamonds) for
R. S. Patrick, Sellwood Building, Duluth, Minn.

CORE DRILLING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Pennsylvania Drilling Co., Pittsburgh, Pa.

COUPLINGS, FLEXIBLE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

CRUSHER OILS
Standard Oil Co. (Ind.), Chicago, Ill.

CRUSHERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Symons Bros. Co., Chicago, Ill.

CRUSHERS, Coal
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

CRUSHERS, SINGLE & DOUBLE ROLL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRYSTAL (Quartz)
Diamond Drill Carbon Co., World Bldg., New York.

CUP GREASE
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42d St., New York City.

CYCLONE DUST COLLECTORS
American Coal Cleaning Corpn., Welch, W. Va.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

DESIGNERS OF PLANTS
American Coal Cleaning Corpn., Welch, W. Va.
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DETONATORS
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

DIAMOND CORE DRILL CONTRACTING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DIAMOND DRILLING CARBON
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, INDUSTRIAL
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMOND TOOLS
Diamond Drill Carbon Co., World Bldg., New York.

DIESEL ENGINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

DIGGERS & PICKS, Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILLERS' DIAMONDS
Diamond Drill Carbon Co., World Bldg., New York.

DRILLING CONTRACTORS
Pennsylvania Drilling Co., Pittsburgh, Pa.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILLING, DIAMONDS FOR
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILL BITS, Carbon (Diamonds) for
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL, CARBON (Diamonds) for
Diamond Drill Carbon Co., World Bldg., New York.
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILL COLUMNS & MOUNTINGS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILL LUBRICANTS
Standard Oil Co. (Ind.), Chicago, Ill.

DRILLER'S DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, CORE
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRILLS (Hand Operated Coal)
Ohio Brass Co., Mansfield, Ohio.

DRILLS, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
Hoffman Bros. Drilling Co., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, ROCK
Diamond Machine Co., Monongahela, Pa.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRIVES, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

DRY CLEANING COAL & COKE
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd. Chicago, Ill.
Roberts & Schaefer Co., Chicago, Ill.

DRYERS, ROTARY
Vulcan Iron Works, Wilkes-Barre, Pa.

DUMP CARS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

DUMPS (Rotary, Cradle, Crossover & Kickback)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co.,
Roberts & Schaefer Co., Chicago, Ill. Pittsburgh, Pa.

DUST COLLECTING EQUIPMENT
American Coal Cleaning Corpn., Welch, W. Va.

DUST FILTERS
American Coal Cleaning Corpn., Welch, W. Va.

DYNAMITE
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

DYNAMOS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

DYNAMO OILS
Standard Oil Co. (Ind.), Chicago, Ill.

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRICAL CABLES & WIRES
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
Roebling's Sons Co., John A., Trenton, N. J.

ELECTRIC BLASTING CAPS
Hercules Powder Co., Wilmington, Del.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRIC LOCOMOTIVE CABLES
John A. Roebling's Sons Co., Trenton, N. J.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRIC MINE SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRIC WIRES AND CABLES
General Electric Co., Schenectady, N. Y.
American Steel & Wire Co., Chicago, Ill., and New York.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELECTRICAL WIRES AND CABLES
John A. Roebling's Sons Co., Trenton, N. J.

ELECTRODES, WELDING
John A. Roebling's Sons Co., Trenton, N. J.

ELEVATORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ELEVATORS, BUCKET
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ELEVATOR CABLES & ROPES
John A. Roebling's Sons Co., Trenton, N. J.

ELEVATOR AND HOIST MOTORS
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ELEVATOR MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ENGINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

ENGINES, OIL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

EXCAVATORS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

EXHAUSTERS
American Coal Cleaning Corpn., Welch, W. Va.

EXPLOSIVES
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St. Wilmington, Del.

FAN DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS, Man Cooling
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS, Turbine
Robinson Ventilating Co., Zelienople, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Robinson Ventilating Co., Zelienople, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

FEEDERS
Hockensmith Wheel & Mine Car Co., Penn, Pa.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Chicago, Ill.

FEEDERS (Gravity)
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

FEEDERS (Hand Operated)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Chicago, Ill.

FEEDERS, ORE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

FEEDERS (Reciprocating)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

American Coal Cleaning Corpn., Welch, W. Va.

FEEDERS (Semi-automatic)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

FENCE POSTS
Sweet's Steel Co., Williamsport, Pa.

FIBRE GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

FILTER CLOTH, WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

FILTERS (Dust)
American Coal Cleaning Corpn., Welch, W. Va.

FIRE AND WEATHER-PROOF WIRE
John A. Roebling's Sons Co., Trenton, N. J.

FLASHLIGHTS AND BATTERIES (Mine Safety)
National Carbon Co., Inc., 30 East 42d Street, New York City.

FLOORING, OPEN STEEL
Hendrick Mfg. Co., Carbondale, Pa.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FLOTATION OILS
Hercules Powder Co., 934 King St., Wilmington, Del.

FLOW METERS
General Electric Co., Schenectady, N. Y.

FLUX, WELDING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

FORGINGS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FROGS
Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

FROGS AND SWITCHES
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

FURNACE OIL
Standard Oil Co. (Ind.), Chicago, Ill.

FURNACES, Oil (for drill steel)
Ingersoll-Rand Co., 11 Broadway, New York City.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

GAS (Nitrogen, Oxygen)
Linde Air Products Co., 30 E. 42d St., New York City.

GASOLINE
Standard Oil Co. (Ind.), Chicago, Ill.

GAS ENGINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

GAUGES, WELDING & CUTTING
Central Frog & Switch Co., Cincinnati, Ohio.

GAUGE RODS
Central Frog & Switch Co., Cincinnati, Ohio.

GAUGES, WELDING & CUTTING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GEAR COMPOUNDS
Standard Oil Co. (Ind.), Chicago, Ill.

GEARS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS, BEVEL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS (Fabroil & Textolite)
General Electric Co., Schenectady, N. Y.

GEARS, HERRINGBONE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Machine Cut
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Moulded Tooth
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, Silent Chain
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

GEARS, SPUR
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

GEARS, WORM
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GELATIN DYNAMITES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

GENERATORS, ACETYLENE
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GLOVES, ASBESTOS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

GRAPHITE GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

GRATING, AREA, SIDE WALK
Hendrick Mfg. Co., Carbondale, Pa.

GREASE
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

GRINDERS, Portable Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

GUARD RAIL CLAMPS
Central Frog & Switch Co., Cincinnati, Ohio.

GUY ROPES, GALVANIZED
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

HAMMERS, Calking, Chipping & Riveting
Ingersoll-Rand Co., 11 Broadway, New York City.

HANGERS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, 40 E. 34th St., New York City.

HANGERS (Insulated Trolley)
Ohio Brass Co., Mansfield, Ohio.

HANGERS, Ball Bearing
S K F Industries, New York City.

HANGERS, SHAFT, DROP
S K F Industries, New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

HANGERS, SHAFT, POST
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, New York City.

HANGERS, SHAFT, SELF-OILING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, New York City.

HAULAGE ROPE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

HEADLIGHTS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

HEATER CORD
John A. Roebling's Sons Co., Trenton, N. J.

HERRINGBONE GEAR DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

HIGH EXPLOSIVES
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

HOIST DRIVES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTING ROPES
American Steel & Wire Co., Chicago, Ill., and New York.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
John A. Roebling's Sons Co., Trenton, N. J.

HOISTS
American Steel & Wire Co., Chicago, Ill., and New York.
Ingersoll-Rand Co., 11 Broadway, New York City.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, AIR
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTS, PORTABLE
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, Room
Vulcan Iron Works, Wilkes-Barre, Pa.

HOISTS, Room and Gathering
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

HOISTS, Scraper-Loader
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

HOISTS, STEAM
Allis-Chalmers Mfg. Co., Milwaukee. Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Vulcan Iron Works, Wilkes-Barre, Pa.

HOLDERS-ON RIVETING
Ingersoll-Rand Co., 11 Broadway, New York City.

HOOKS
John A. Roebling's Sons Co., Trenton, N. J.

HOSE, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

HOSE, WELDING AND CUTTING
Oxweld Acetylene Co., 30 E. 42d St., New York City.

HYDRATORS, LIME
Vulcan Iron Works, Wilkes-Barre, Pa.

IGNITERS, Electric
Hercules Powder Co., Wilmington, Del.

INCINERATORS
Vulcan Iron Works, Wilkes-Barre, Pa.

INCLINE FROGS
Central Frog & Switch Co., Cincinnati, Ohio.

INCLINE TRACK LAYOUTS
Central Frog & Switch Co., Cincinnati, Ohio.

INSULATORS, FEEDER WIRE
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATORS, SECTION
Amer. Mine Door Co., Canton, Ohio.
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATORS (Porcelain)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATORS (Third Rail)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INSULATED WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
John A. Roebling Sons Co., Trenton, N. J.

KEROSENE
Standard Oil Co. (Ind.), Chicago, Ill.

KILNS (Rotary)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Vulcan Iron Works, Wilkes-Barre, Pa.

KILNS, VERTICAL
Vulcan Iron Works, Wilkes-Barre, Pa.

LAMP CORD
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

LAMPS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co., 30 E. 42d St., New York City.

LIGHT AND POWER PLANTS (Small)
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LIGHT STEEL ANGLES
Sweet's Steel Co., Williamsport, Pa.
Carnegie Steel Co., Pittsburgh, Pa.

LIGHT STEEL RAILS
Carnegie Steel Co., Pittsburgh, Pa.
West Virginia Rail Co., Huntington, W. Va.

LIGHT STEEL RAILS (A. S. C. E. Sections)
Sweet's Steel Co., Williamsport, Pa.

LINE SHAFT
S K F Industries, 40 E. 34th St., New York City.

LOADERS, Gravel and Sand
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS (Mine Car)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Myers-Whaley Co., Knoxville, Tenn.

LOADERS, PORTABLE
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Joy Manufacturing Co., Franklin Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Myers-Whaley Co., Knoxville, Tenn.

LOADERS, Snow
Joy Manufacturing Co., Franklin Pa.

LOADERS, Truck
Joy Manufacturing Co., Franklin Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS, Wagon
Joy Manufacturing Co., Franklin, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Conveyor Sales Co., 299 Broadway, New York City.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Myers-Whaley Co., Knoxville, Tenn.

LOCOMOTIVES, ELECTRIC
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVES, GASOLINE
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVES, RACK RAIL
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

LOCOMOTIVES, STEAM
Vulcan Iron Works, Wilkes-Barre, Pa.

LOCOMOTIVES, STORAGE BATTERY
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LOCOMOTIVE SWITCHING & WRECKING ROPES
John A. Roebling's Sons Co., Trenton, N. J.

LOCOMOTIVES (Third Rail)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

LOCOMOTIVES, TROLLEY
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Vulcan Iron Works, Wilkes-Barre, Pa.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

LONGWALL MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

LUBRICANTS
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

LUBRICATORS
Keystone Lubricating Co., Philadelphia, Pa.

MACHINE OILS
Standard Oil Co. (Ind.), Chicago, Ill.

MACHINERY, TRANSMISSION (Power)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

MANIFOLDS, OXYGEN
Oxweld Acetylene Co., 30 E. 42d St., New York City.

MAST ARM ROPE, Galvanized
John A. Roebling's Sons Co., Trenton, N. J.

MILL GREASES
Standard Oil Co. (Ind.), Chicago, Ill.

MILLS, ROD & BALL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MILLS, STAMPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINE CAR AXLES
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE CAR BEARINGS
Hyatt Roller Bearing Co., Newark, N. J.
Timken Roller Bearing Co., Canton, Ohio.

MINE CAR BOXES
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE CAR FORGINGS
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE CAR LUBRICANTS
Keystone Lubricating Co., Philadelphia, Pa.
Standard Oil Co. (Ind.), Chicago, Ill.

MINE CAR PARTS
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

MINE CAR ROLLER BEARINGS
American Car & Foundry Co., 30 Church St., New York City.

MINE CARS
American Car & Foundry Co., 30 Church St., New York City.
Enterprise Wheel & Car Corporation, Huntington, W. Va.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

MINE CAR WHEELS
American Car & Foundry Co., 30 Church St., New York City.
Hockensmith Wheel & Mine Car Co., Penn, Pa.

MINE DOORS, AUTOMATIC
American Mine Door Co., Canton, Ohio.

MINE LOCOMOTIVE CABLE
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

MINE TIES
Central Frog & Switch Co., Cincinnati, Ohio.

MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING MACHINE CABLE
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

MINING MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

MINING MACHINES (Electric)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING MACHINES (Government Approved)
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINERY
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MINING MACHINERY BEARINGS
Hyatt Roller Bearing Co., Newark, N. J.

MOTOR OILS
Standard Oil Co. (Ind.), Chicago, Ill.

MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOTORS, Electric
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

MOUNTED BOTTOM CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

MOVING PICTURE CORD
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

NITROGEN GAS
Linde Air Products Co., 30 East 42d St., New York City.

OILS
Standard Oil Co. (Ind.), Chicago, Ill.

ORE, BUYERS AND SELLERS OF
Irvington Smelting & Refining Works, Irvington, N. J.

ORE, CARNOTITE & VANADIUM
O. Barlow Willmarth, Georgetown, Colo.

OVERCUTTING MACHINES
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

OXYGEN GAS
Linde Air Products Co., 30 East 42d St., New York City.

OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co., 30 E. 42d St., New York City.

PAVING BREAKERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

PERFORATED METAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

PERMISSIBLES, Explosives
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

PETROLATUMS
Standard Oil Co. (Ind.), Chicago, Ill.

PICKING TABLES
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

PIPE (Genuine Wrought Iron)
A. M. Byers Co., Pittsburgh, Pa.

PIPE (Wood)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PNEUMATIC COAL SEPARATING MACHINERY
American Coal Cleaning Corp., Welch, W. Va.

PNEUMATIC SIZING MACHINERY
American Coal Cleaning Corp., Welch, W. Va.

PNEUMATIC TOOL
Ingersoll-Rand Co., 11 Broadway, New York City.

PNEUMATIC TOOL LUBRICANT
Standard Oil Co. (Ind.), Chicago, Ill.

PORTABLE TRACK
Central Frog & Switch Co., Cincinnati, Ohio.

PORTABLE TURNOUTS
Central Frog & Switch Co., Cincinnati, Ohio.

POWDER BLASTING
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

POWER CABLES
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
John A. Roebling's Sons Co., Trenton, N. J.

POWER SHOVELS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PREHEATING APPARATUS
Oxweld Acetylene Co., 30 E. 42d St., New York City.

PRESSURE GUN GREASE
Standard Oil Co. (Ind.), Chicago, Ill.

PROSPECTIVE DRILLS
Hoffman Bros. Drilling Co., Punxsatawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Pennsylvania Drilling Co., Pittsburgh, Pa.

PULLEYS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

PULLEYS, BALL OR ROLLER BEARING
S K F Industries, New York City

PULLEYS, CLUTCH, FRICTION
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
S K F Industries, New York City.

PULLEYS, LOOSE
S K F Industries, New York City.

PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

PUMPS, Acid Resisting
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

PUMPS, Boiler Feed
Ingersoll-Rand Co., 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, DEEP WELL
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS (Electric)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PUMPS, Fire
Ingersoll-Rand Co., 11 Broadway, New York City.

¶ **Announcement of the Annual Coal Convention and Exposition will be found on page 173, this issue.**

PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PUMPS, Inclined Shaft
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, MINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, Sinking
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, POWER
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, VACUUM
Ingersoll-Rand Co., 11 Broadway, New York City.

PUNCHES, Drill Steel
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

QUARRYING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

QUARTZ CRYSTAL
Diamond Drill Carbon Co., World Bldg., New York.

RADIO ACTIVE ORE
O. Barlow Willmarth, Georgetown, Colo.

RADIUM ORE
O. Barlow Willmarth, Georgetown, Colo.

RAIL BONDS
American Steel & Wire Co., Chicago, Ill., and New York.
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

RAIL BRACES
Central Frog & Switch Co., Cincinnati, Ohio.

RAILWAY SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

RAMMERS, Pneumatic
Ingersoll-Rand Co., 11 Broadway, New York City.

RECEIVERS, AIR
Ingersoll-Rand Co., 11 Broadway, New York City.

REGULATORS, Welding and Cutting, Compressed Gas
Oxweld Acetylene Co., 30 E. 42d St., New York City.

REHEATERS, Air
Ingersoll-Rand Co., 11 Broadway, New York City.

REINFORCING BARS
Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

RESCUE APPARATUS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

RETARDERS
Mining Safety Device Co., Bowerston, Ohio.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

RIVER CROSSING SUSPENSION WIRE, Galvanized
John A. Roebling's Sons Co., Trenton, N. J.

ROCK-DISPOSAL EQUIPMENT
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

ROCK DRILLS
Ingersoll-Rand Co., 11 Broadway, New York City.

ROCK DUSTING EQUIPMENT
American Mine Door Co., Canton, Ohio.

RODS, WELDING
Ohio Brass Co., Mansfield, Ohio.
Oxweld Acetylene Co., 30 E. 42d St., New York City.

ROLLER BEARINGS
Enterprise Wheel & Car Corporation, Huntington, W. Va.
Hyatt Roller Bearing Co., Newark, N. J.
Timken Roller Bearing Co., Canton, Ohio.

ROLLERS
C. S. Card Iron Works Co., 16th & Alcott Sts., Denver, Colo.

ROLLS (Crushing)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ROPE
American Steel & Wire Co., Chicago, Ill., and New York.

ROPE GREASE
Keystone Lubricating Co., Philadelphia, Pa.

ROPE, TRANSMISSION
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

ROPE, WIRE
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

ROTARY DRYERS
Vulcan Iron Works, Wilkes-Barre, Pa.

ROTARY COOLERS
Vulcan Iron Works, Wilkes-Barre, Pa.

ROTARY DUMPS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Mining Safety Device Co., Bowerston, Ohio.
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

ROTARY ROASTERS
Vulcan Iron Works, Wilkes-Barre, Pa.

RUNNING ROPE, Galvanized
American Steel & Wire Co., Chicago, Ill., and New York.
John A. Roebling's Sons Co., Trenton, N. J.

SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

SAFETY FUSE
Hercules Powder Co., Wilmington, Del.

SAFETY FUSE & WIRES—LEADING & CONNECTING
E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del.

SAND DRYERS
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SASH CORD
John A. Roebling's Sons Co., Trenton, N. J.

SAWS (Air)
Ingersoll-Rand Co., 11 Broadway, New York City.

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Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

SCREEN BARS
Phillips Mine & Mill Supply Co., Pittsburgh, Pa.

SCREENS (Anti-Gravity)
American Coal Cleaning Corpn., Welch, W. Va.

SCREENS, ARCH-CRIMP
Ludlow Saylor Wire Co., St. Louis, Mo.

SCREENS, DOUBLE CRIMPED
Ludlow Saylor Wire Co., St. Louis, Mo.

SCREENS, HORIZONTAL
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
W. S. Tyler Co., Cleveland, Ohio.

SCREENS, PERFORATED METAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS, REK-TANG
Ludlow Saylor Wire Co., St. Louis, Mo.

SCREENS, REVOLVING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS, SHAKER
Hendrick Mfg. Co., Carbondale, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

SCREENS (Vibrating)
American Coal Cleaning Corpn., Welch, W. Va.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
W. S. Tyler Company, Cleveland, Ohio

SCREENS & WASHERIES
American Rheolaveur Corporation, Wilkes-Barre, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SCREENS, WOVEN WIRE
Ludlow Saylor Wire Co., St. Louis, Mo.

SEIZING STRAND, GALVANIZED
John A. Roebling's Sons Co., Trenton, N. J.

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Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

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C. S. Card Iron Works Co., 16th & Alcott Sts., Denver, Colo.
Hockensmith Wheel & Mine Car Co., Penn, Pa.
John A. Roebling's Sons Co., Trenton, N. J.
Vulcan Iron Works, Wilkes-Barre, Pa.

SHEAVE WHEELS
Hockensmith Wheel & Mine Car Co., Penn, Pa.
Vulcan Iron Works, Wilkes-Barre, Pa.

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Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Hyatt Roller Bearing Co., Newark, N. J.
Sullivan Machinery Co., 122 So. Mich. Ave., Chicago, Ill.

SHOVELS, ELECTRIC
Myers-Whaley Co., Knoxville, Tenn.

SHOVEL—ELECTRO-HYDRAULIC
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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
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Sweet's Steel Co., Williamsport, Pa.
West Virginia Rail Co., Huntington, W. Va.

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Sweet's Steel Co., Williamsport, Pa.

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Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

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Central Frog & Switch Co., Cincinnati, Ohio.
Sweet's Steel Co., Williamsport, Pa.

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Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK BRACES
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Standard Oil Co. (Ind.), Chicago, Ill.

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Clippings typical of the interest shown by the industry in the announcement of the mechanization survey undertaken by the recently organized National Committee on Mechanized Mining. Reports of this survey will appear in The Mining Congress Journal

THE MECHANIZATION SURVEY

A SERVICE OF THE AMERICAN MINING CONGRESS

INDEX TO ADVERTISERS

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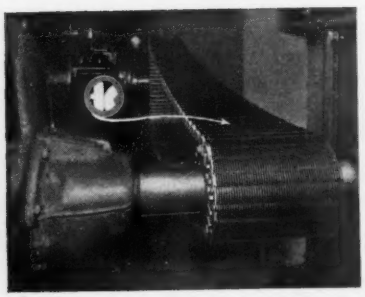

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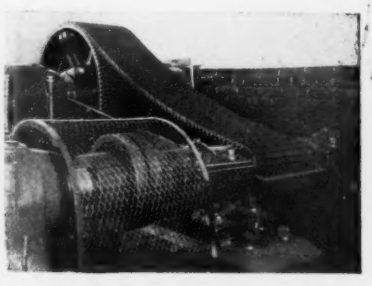

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